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Software Security Knowledge: CWE

Knowing what could make software vulnerable to attack

Robert A. Martin
Sean Barnum

May 2011



Report Documentation Page				Form Approved OMB No. 0704-0188	
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a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Agenda

8:00-8:45am	Software Security Knowledge about Applications Weaknesses
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9:00-9:45am	Software Security Knowledge about Attack Patterns Against Applications
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Training in Software Security

10:15-11:00am	Software Security Practice
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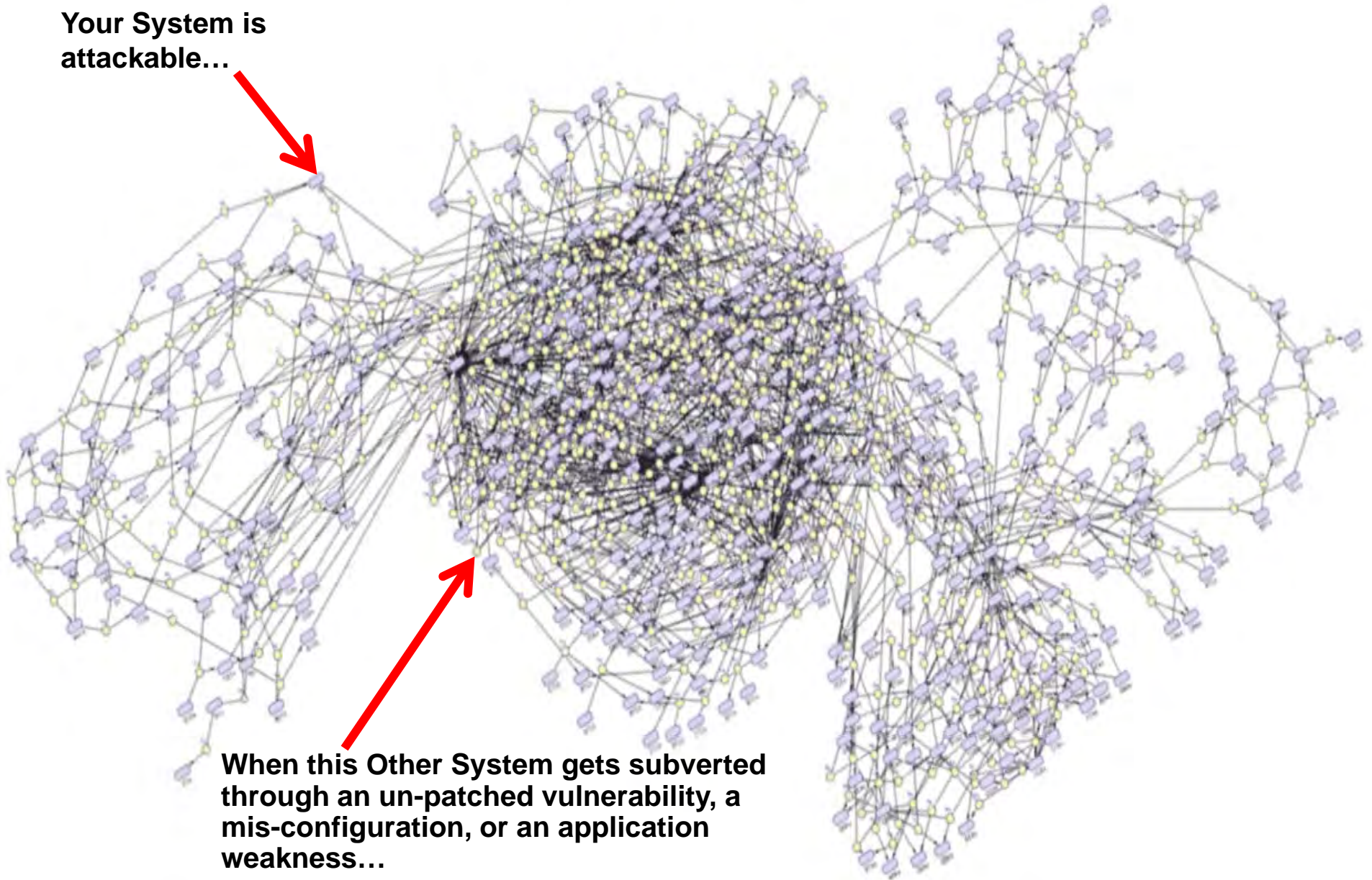
11:15-12:00am	Supporting Capabilities
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Assurance Cases

Secure Development & Secure Operations

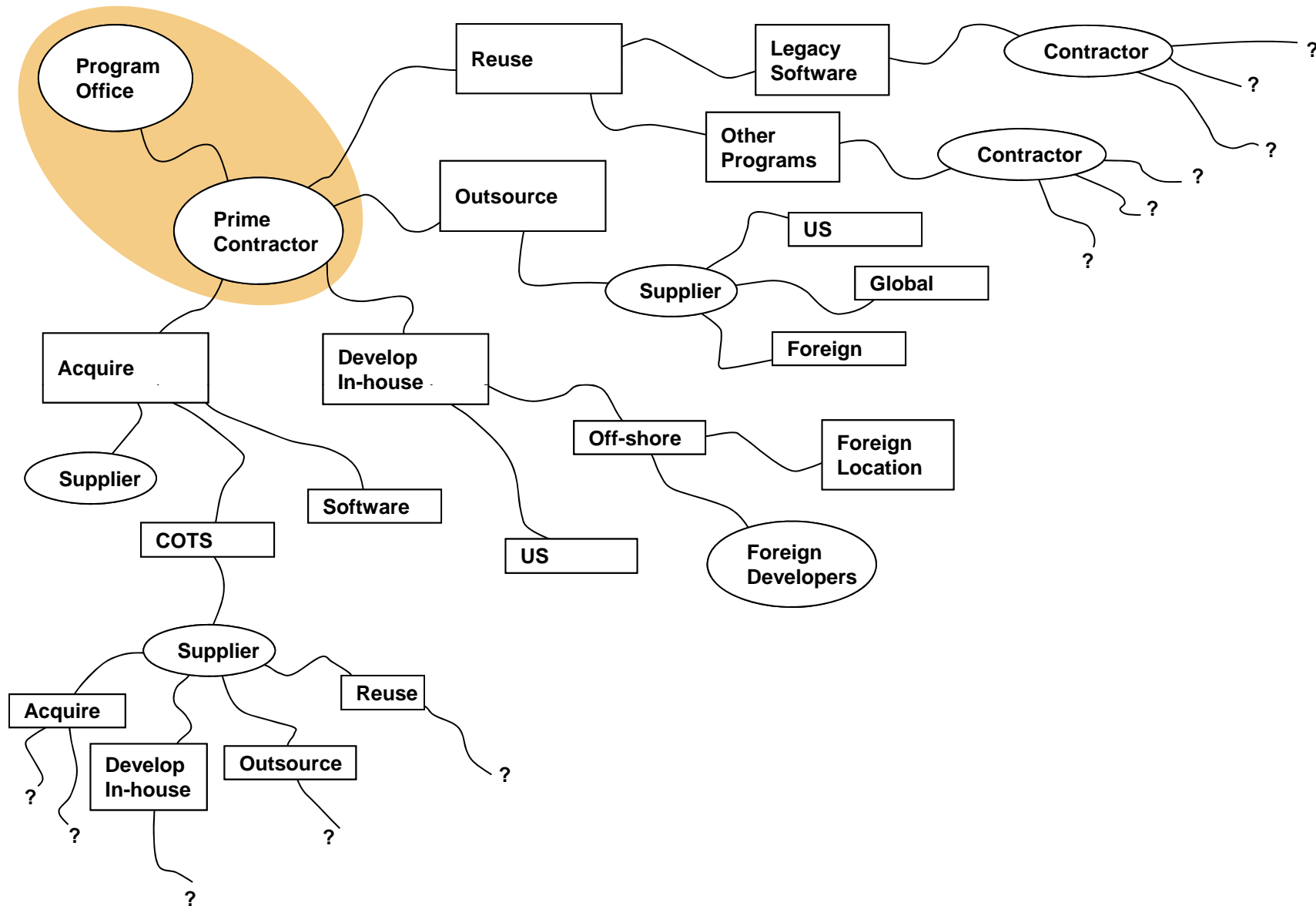
Today Everything's Connected

**Your System is
attackable...**



**When this Other System gets subverted
through an un-patched vulnerability, a
mis-configuration, or an application
weakness...**

The Software Supply Chain

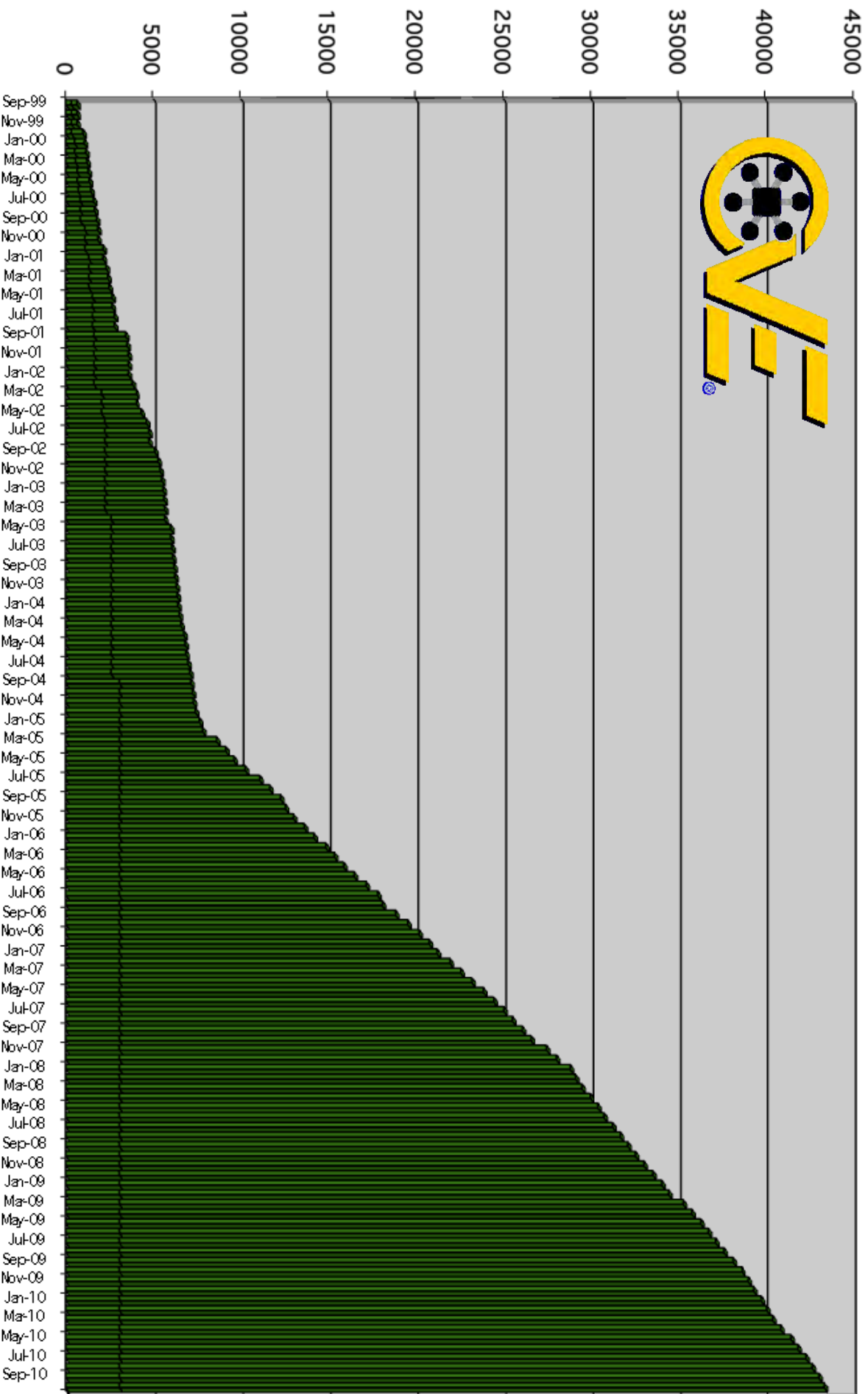


* “Scope of Supplier Expansion and Foreign Involvement” graphic in DACS www.softwaretchnews.com Secure Software Engineering, July 2005 article “Software Development Security: A Risk Management Perspective” synopsis of May 2004 GAO-04-678 report “Defense Acquisition: Knowledge of Software Suppliers Needed to Manage Risks”

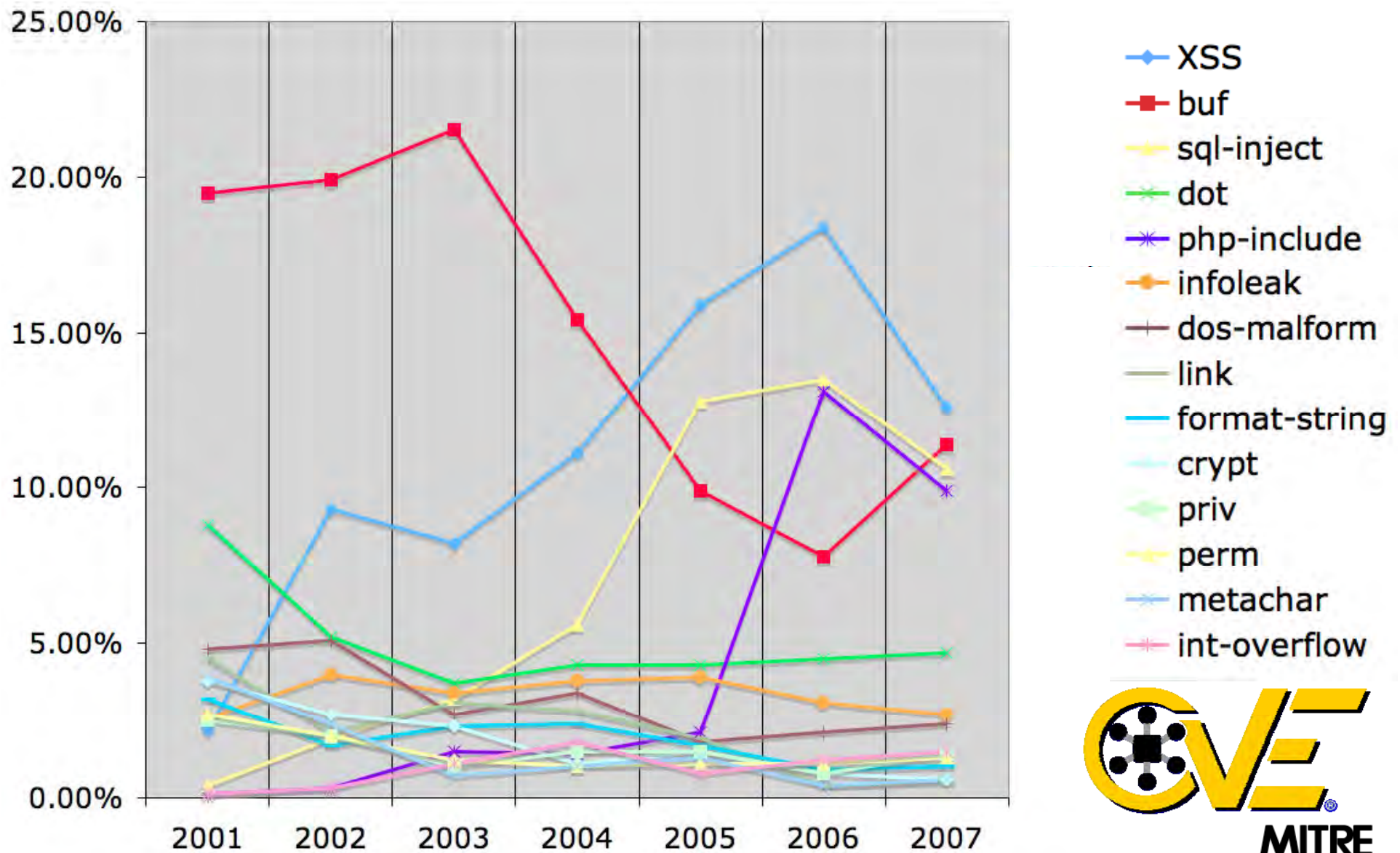
**If the weaknesses
in software were as
easy to spot and
their impact as
obvious as...**



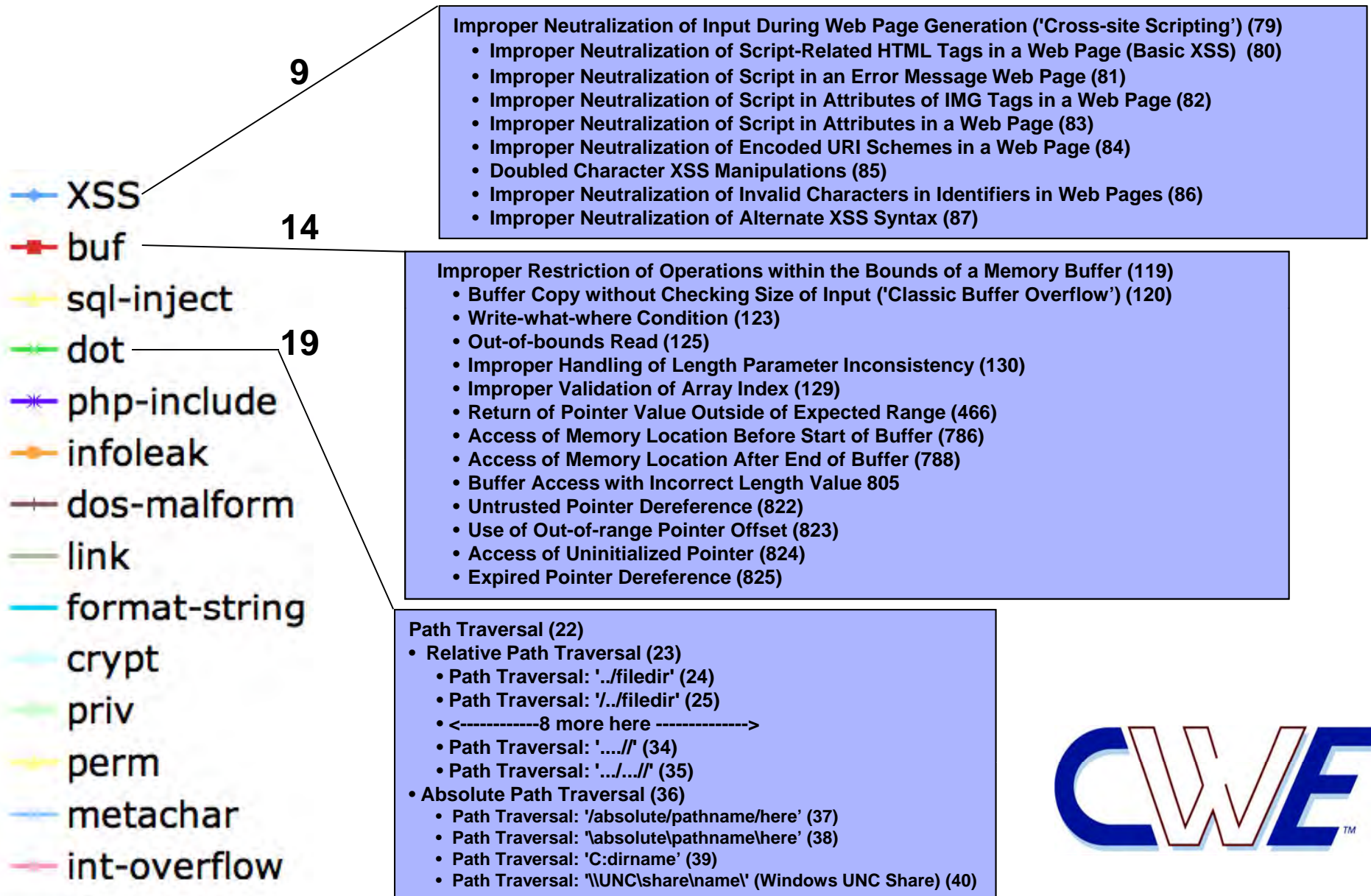
CVE 1999 to 2011



Vulnerability Type Trends: A Look at the CVE List (2001 - 2007)



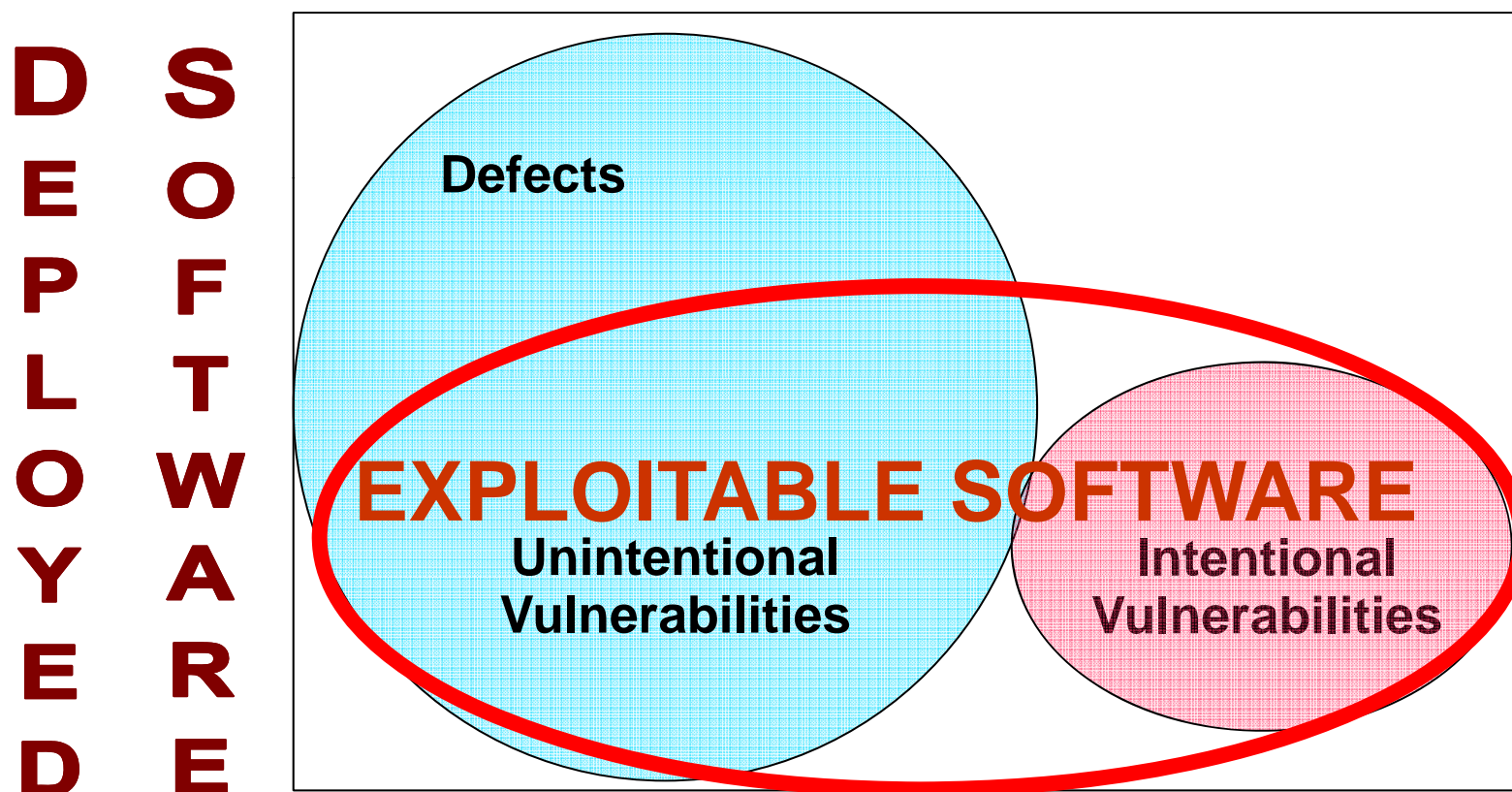
Removing and Preventing the Vulnerabilities Requires More Specific Definitions...CWEs



Exploitable Software Weaknesses (a.k.a. Vulnerabilities)

Vulnerabilities can be the outcome of non-secure practices and/or malicious intent of someone in the development/support lifecycle.

The exploitation potential of a vulnerability is independent of the “intent” behind how it was introduced.



Intentional vulnerabilities are spyware & malicious logic deliberately imbedded (and might not be considered defects but they can make use of the same weakness patterns as unintentional mistakes)

Note: Chart is not to scale – notional representation -- for discussions

Common Weakness Enumeration (CWE)

- dictionary of weaknesses
 - weaknesses that can lead to exploitable vulnerabilities (i.e. CVEs)
 - the things we don't want in our code, design, or architecture
 - web site with XML of content, sources of content, and process used
- structured views
 - provides multiple views into CWE dictionary content
 - supports alternate views – developer/researcher/sub-views
- open community process
 - to facilitate common terms/concepts/facts and understanding
 - allows for vendors, developers, system owners and acquirers to understand tool capabilities/coverage and priorities
 - utilize community expertise

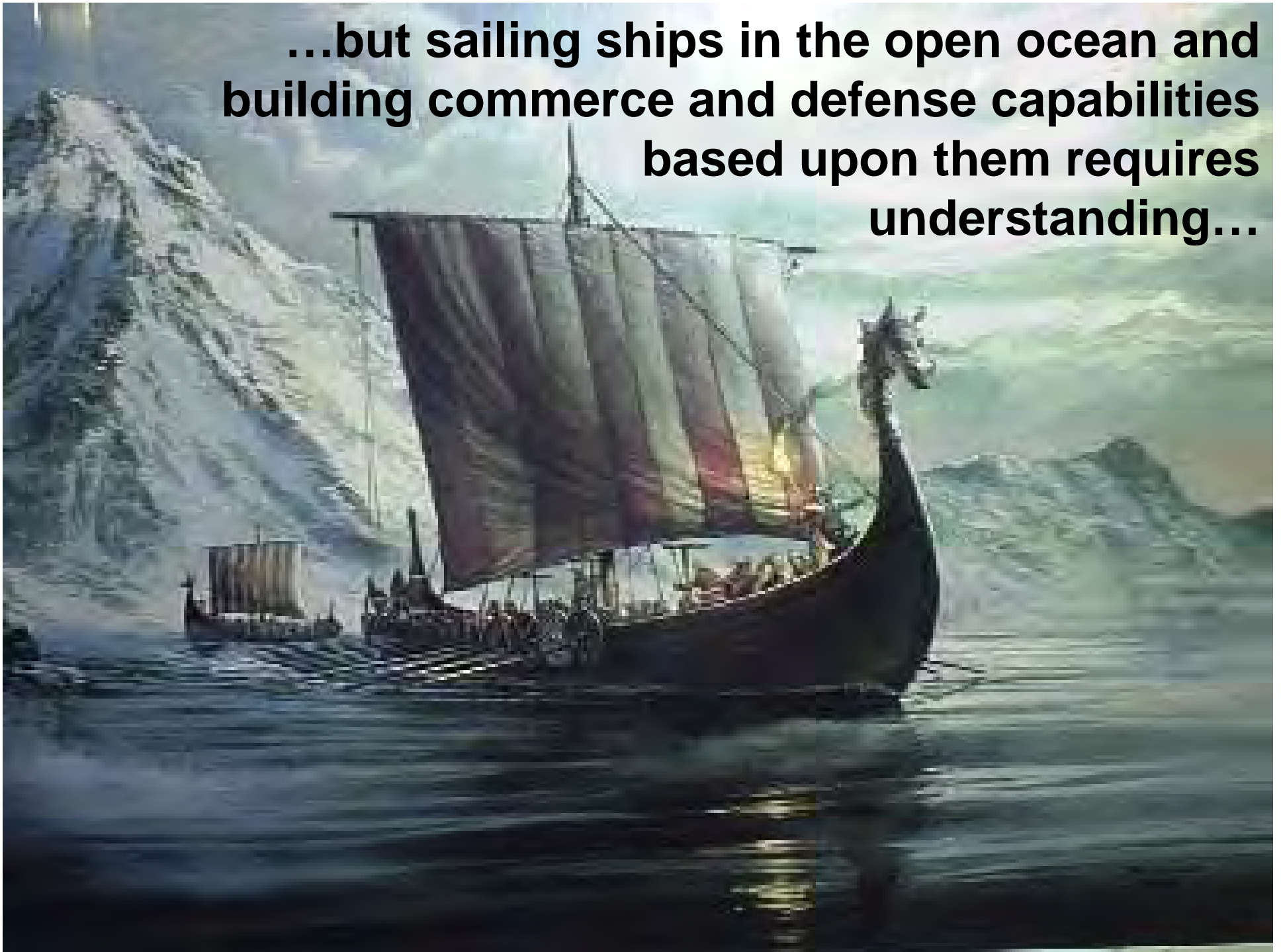
**Foundation for
other DHS, NSA,
OSD, NIST, OWASP,
SANS, and OMG
SwA Efforts**



Building **Software**
only require a few
skills and basic
understanding...



**...but sailing ships in the open ocean and
building commerce and defense capabilities
based upon them requires
understanding...**



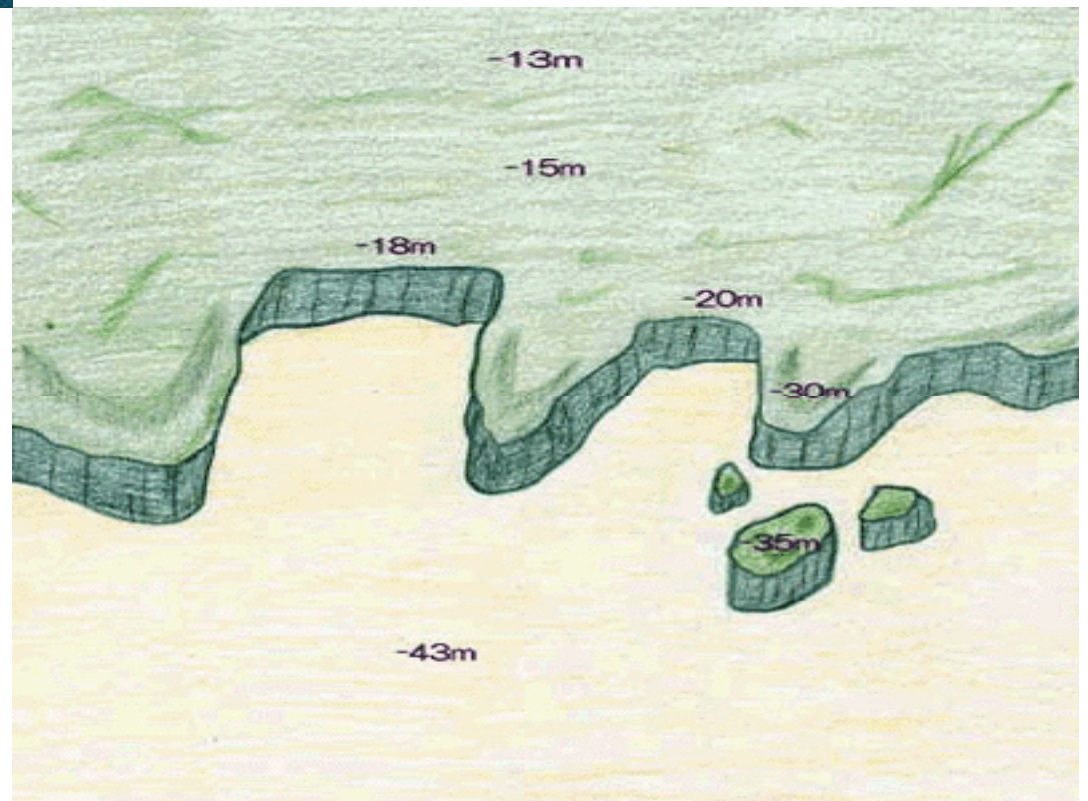
...of navigation threats...

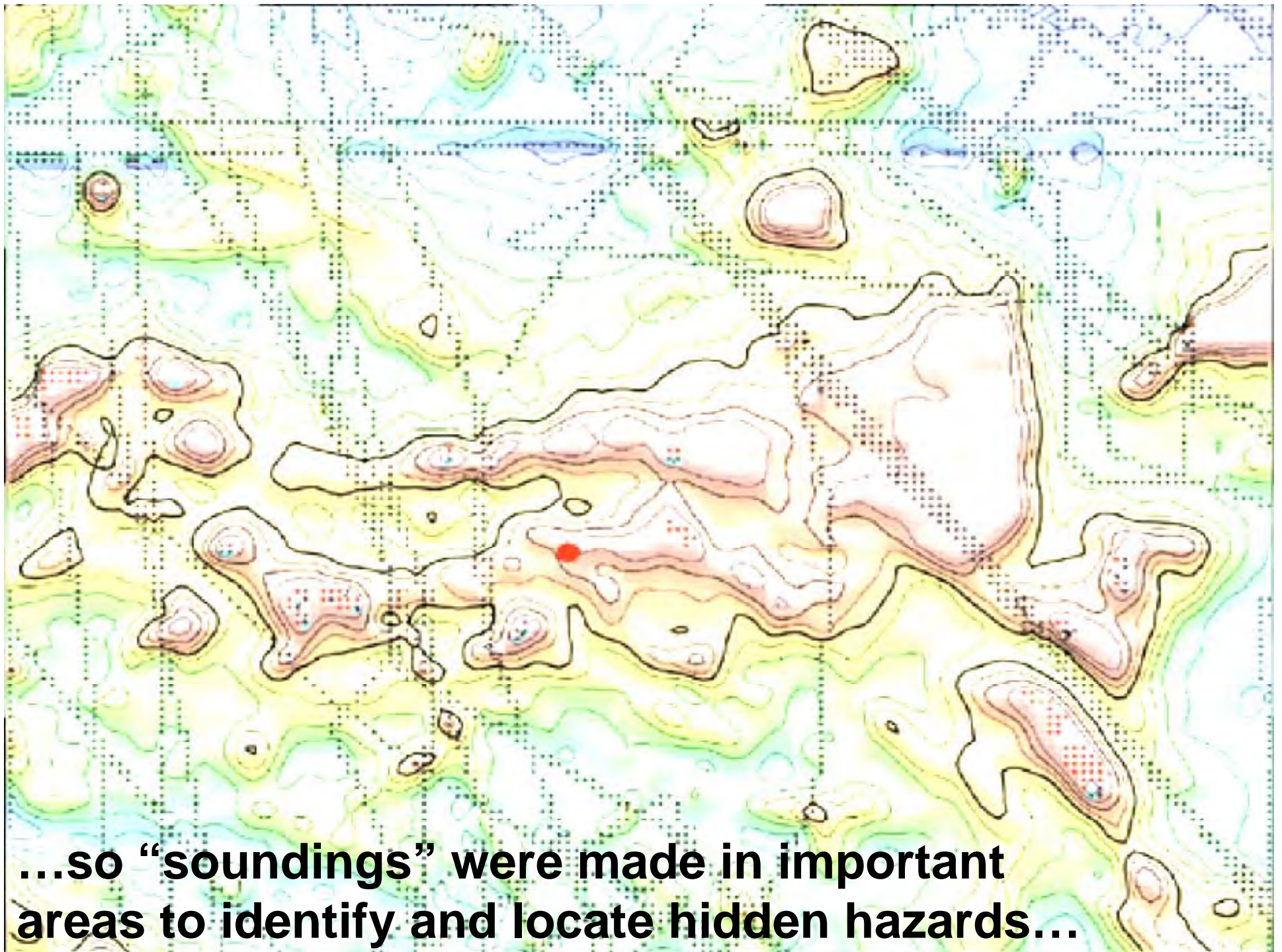




...surface maps didn't capture the full set of threats and hazards – i.e. what was really going on...

...a more insightful depiction – one that shows what was going on under the surface – was needed...



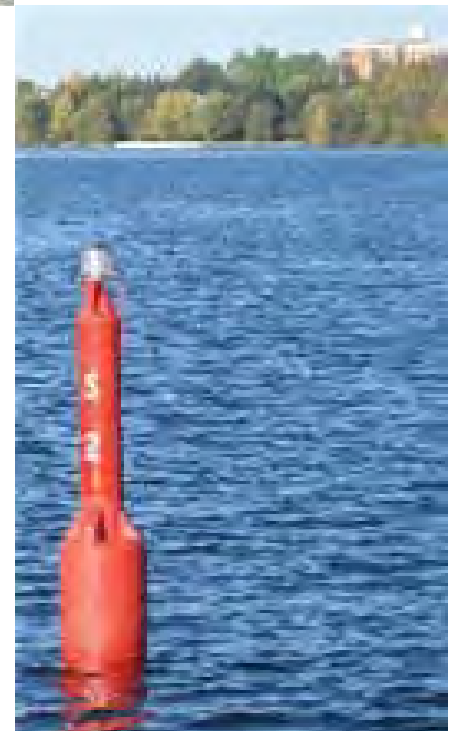


...so “soundings” were made in important areas to identify and locate hidden hazards...

**...and warning signals
to help others avoid
known hazards were
erected along with...**

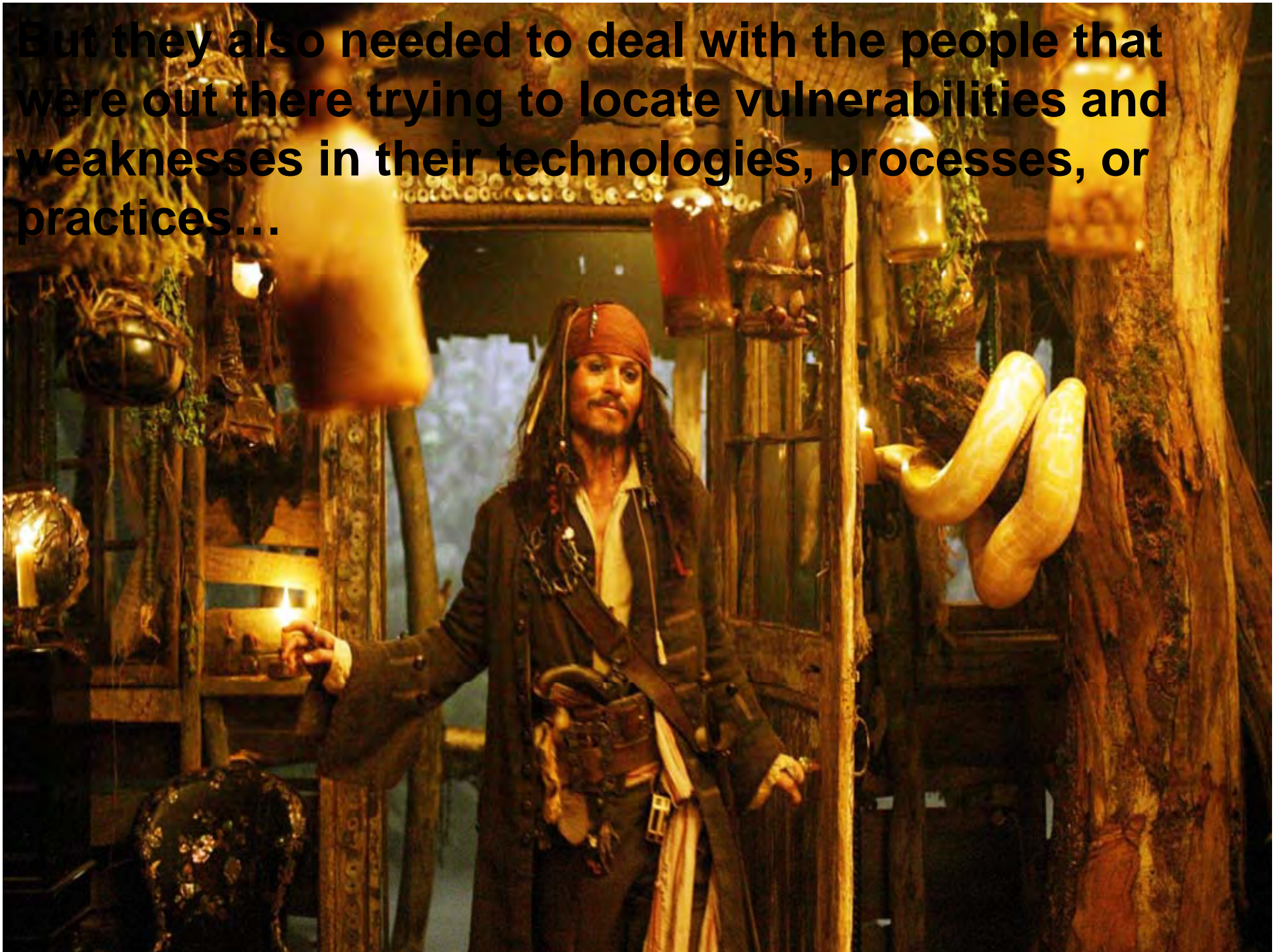


**...indicators
showing safe
ways to avoid
the known
hazards...**

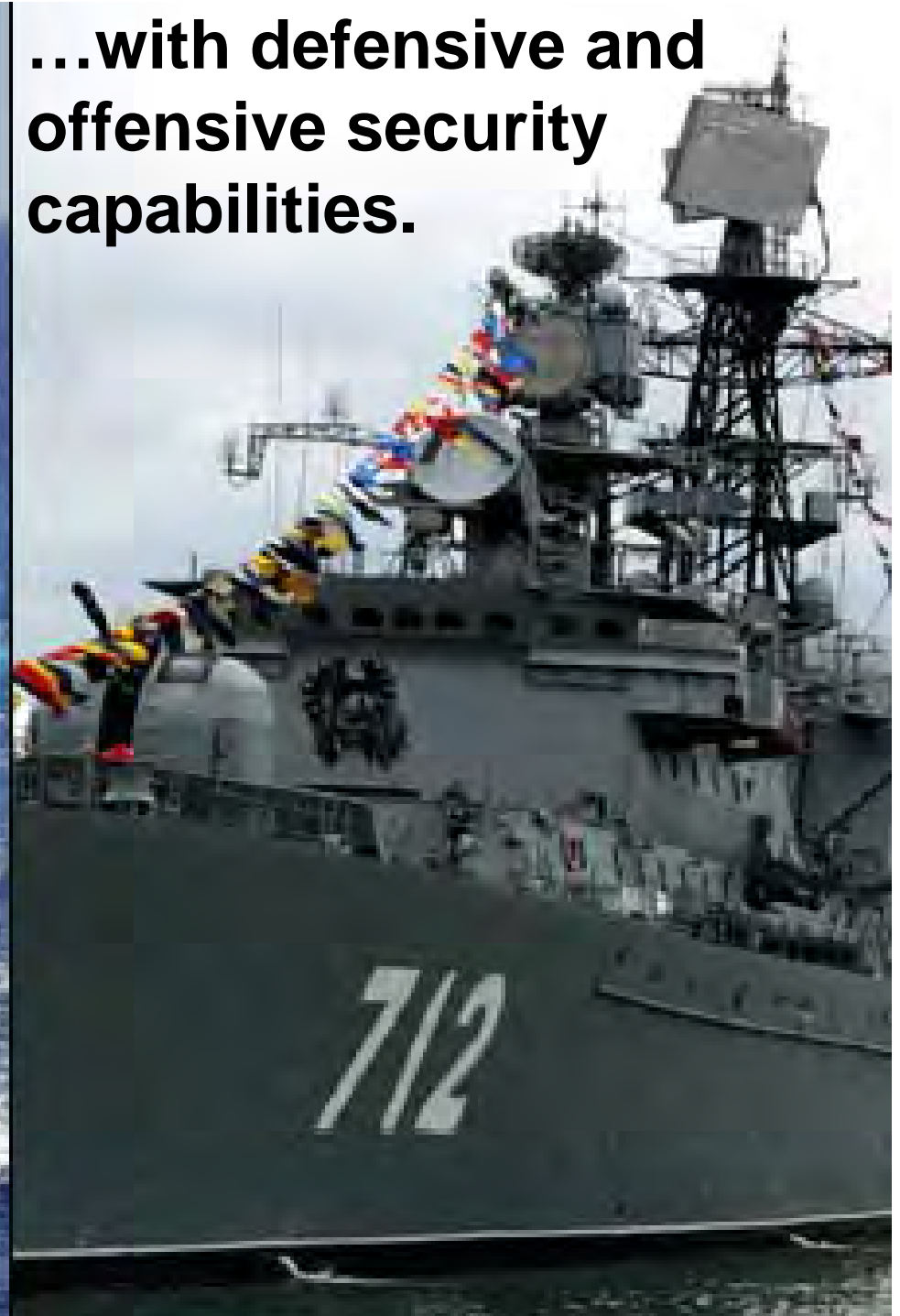


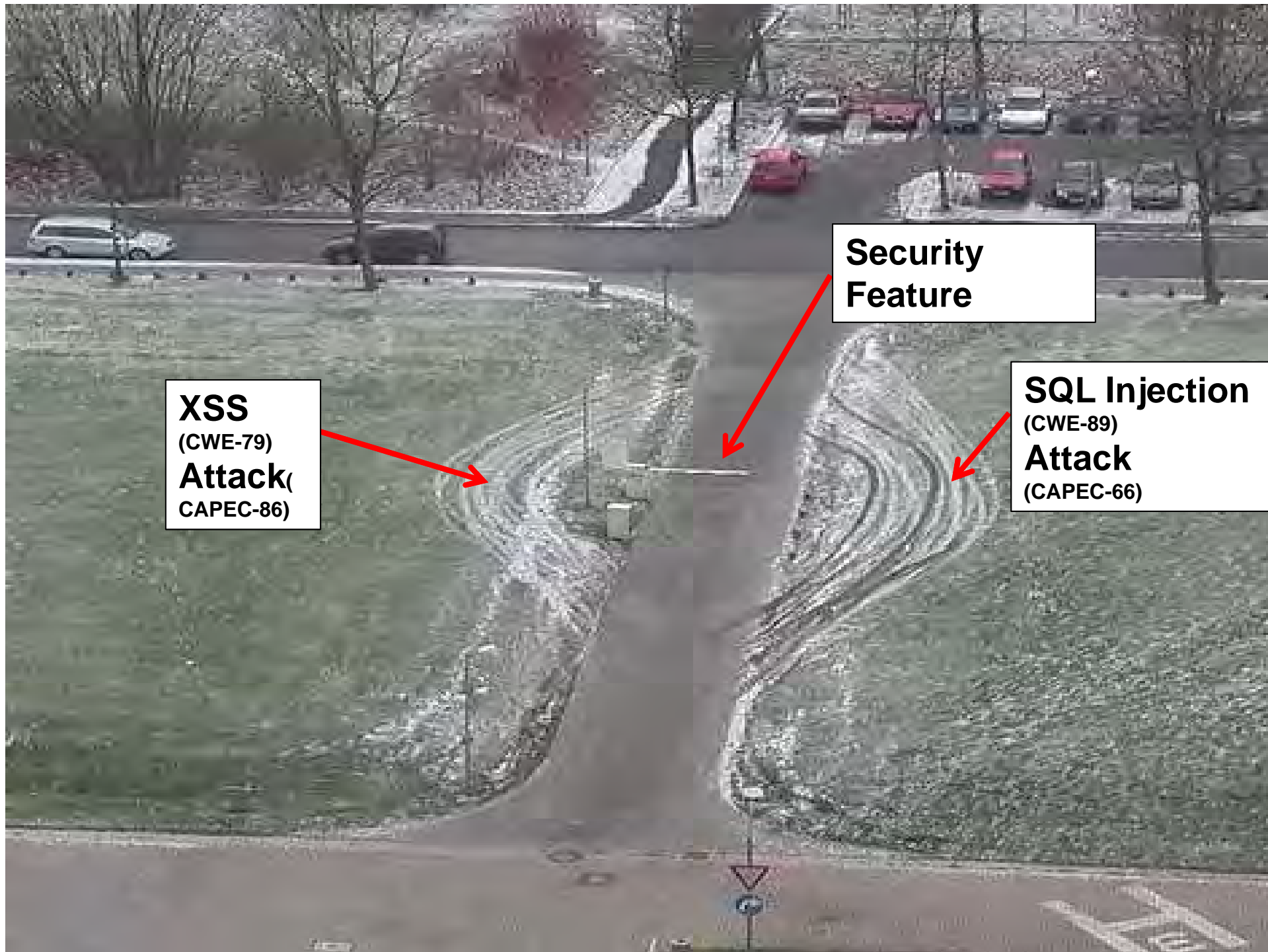


But they also needed to deal with the people that were out there trying to locate vulnerabilities and weaknesses in their technologies, processes, or practices...



**...with defensive and
offensive security
capabilities.**





XSS
(CWE-79)
Attack
(CAPEC-86)

**Security
Feature**

SQL Injection
(CWE-89)
Attack
(CAPEC-66)

Software [In]security: Cyber Warmongering and Influence Peddling



By [Gary McGraw](#) and [Ivan Arce](#)

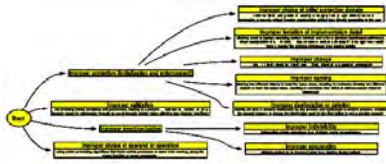
Nov 24, 2010

Article is provided courtesy of Addison-Wesley Professional

“For years in computer security, we have been attempting to protect the broken stuff from the bad people by placing a barrier between the bad people and the broken stuff. We have failed. Instead, we need to fix the broken stuff so that attacking it successfully takes far more resources and skill than is currently the case.”



Protection Analysis



RISOS



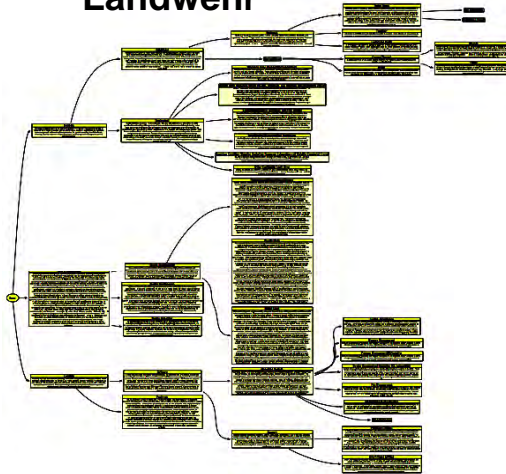
Bishop



Aslam



Landwehr



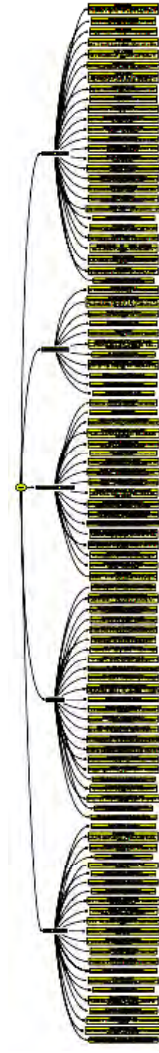
Weber



OWASP



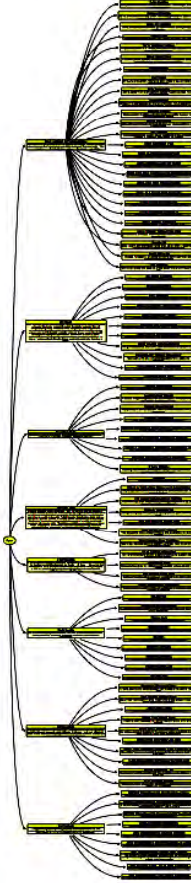
CLASP



Microsoft



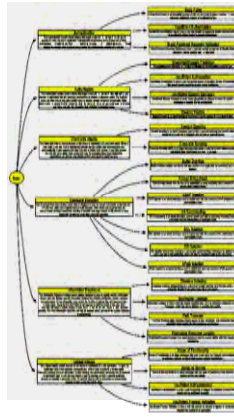
7 Kingdoms



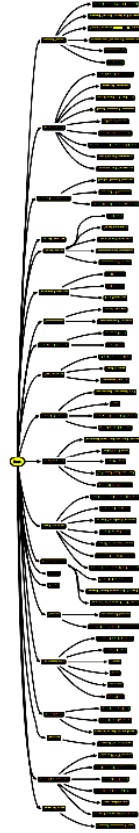
PLOVER



WASC

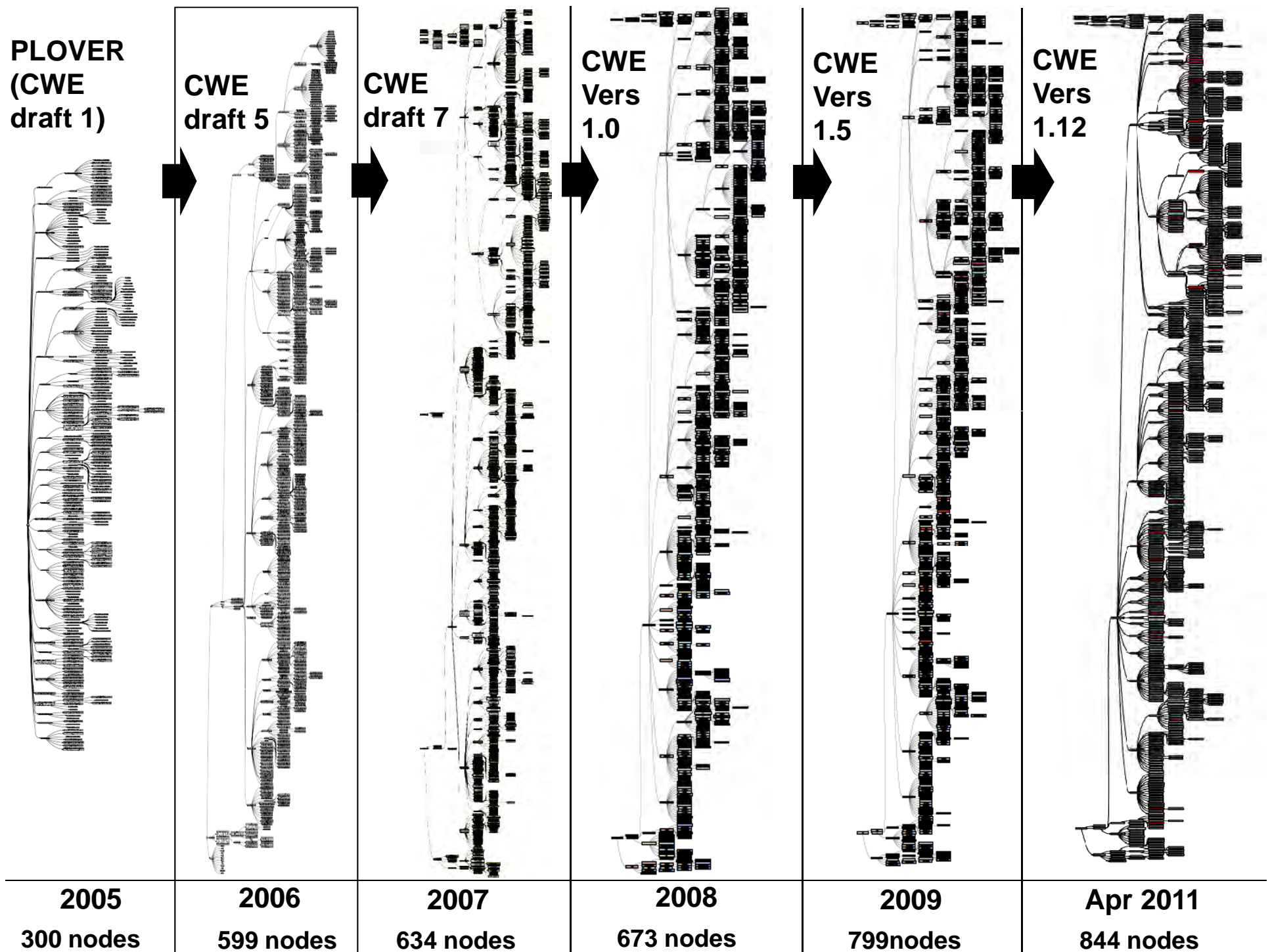


Tool B



Tool A

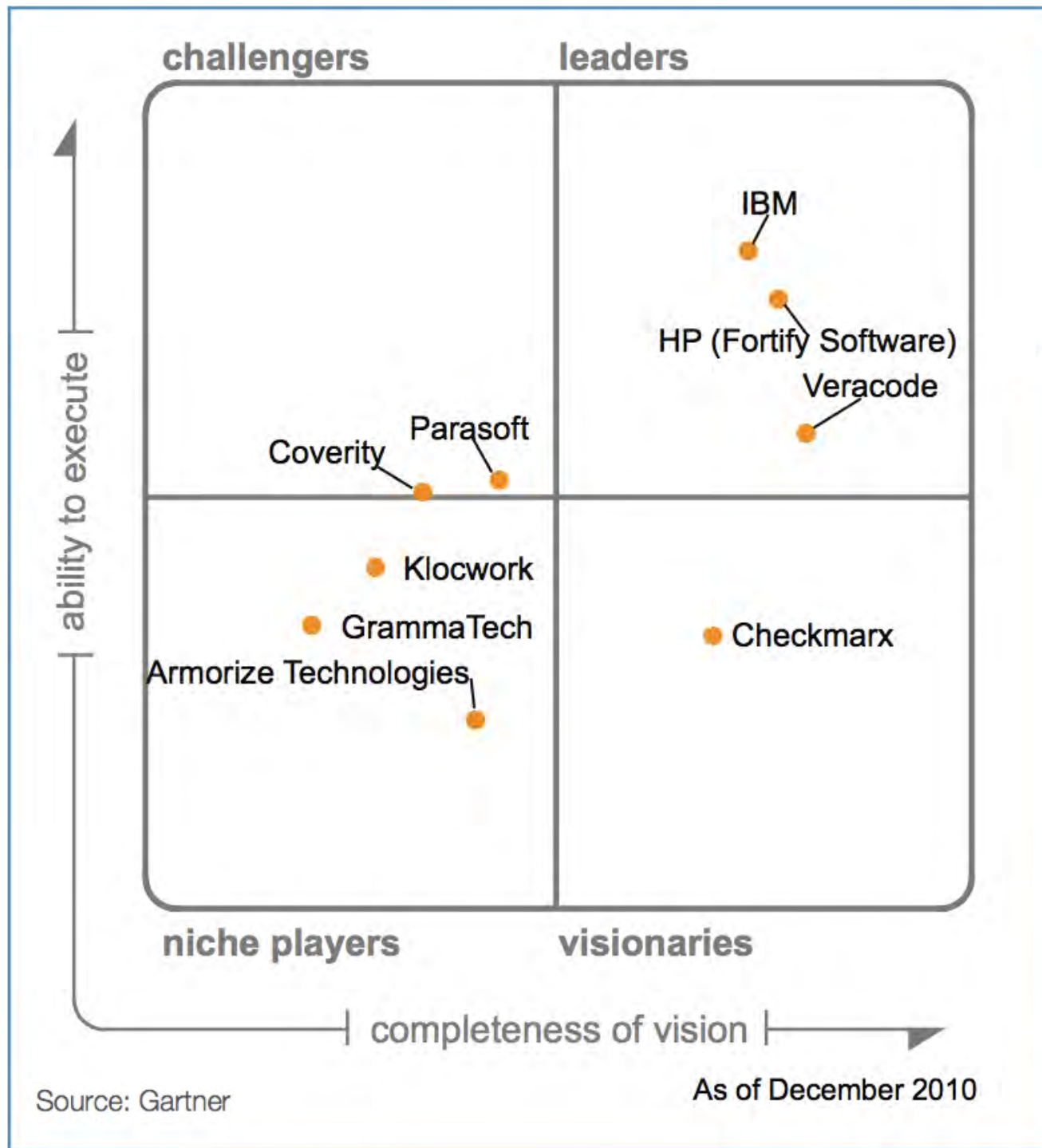




Gartner Magic Quadrant for Static Application Security Testing Tools

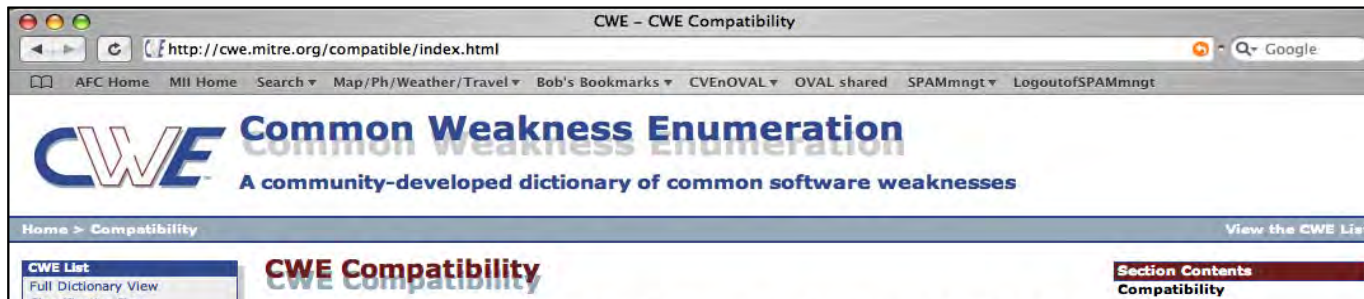
Plus Some Other Important Tool Players...

Cenzic
CAST Software
Polyspace
Security Innovation
LDRA
KDM Analytics
SureLogic
Programming Research Inc
SofCheck



CWE Compatibility & Effectiveness Program

(launched Feb 2007)



Organizations Participating

All organizations participating in the CWE Compatibility and Effectiveness Program are listed below, including those with CWE-Compatible Products and Services and those with Declarations to Be CWE-Compatible.

Products are listed alphabetically by organization name:

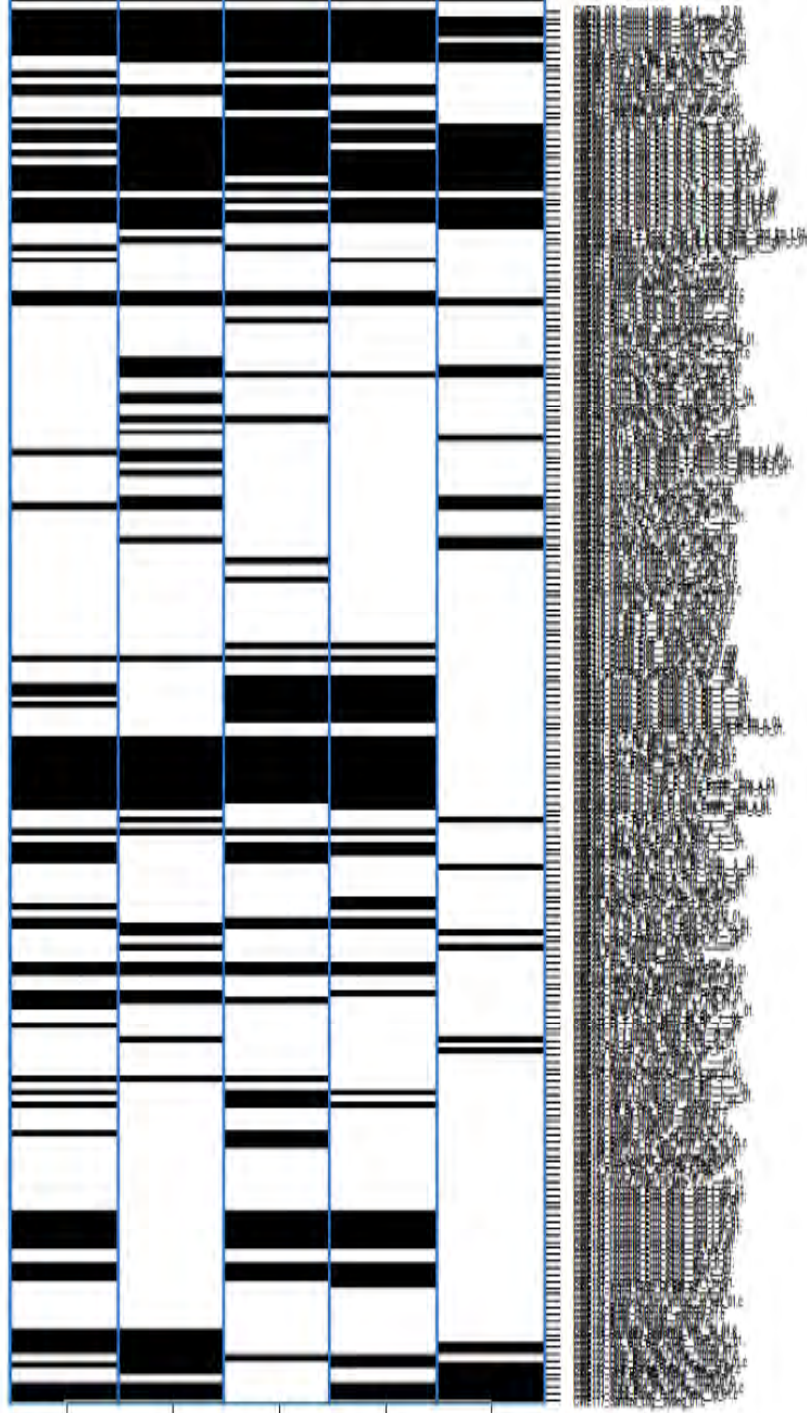
cwe.mitre.org/compatible/

TOTALS

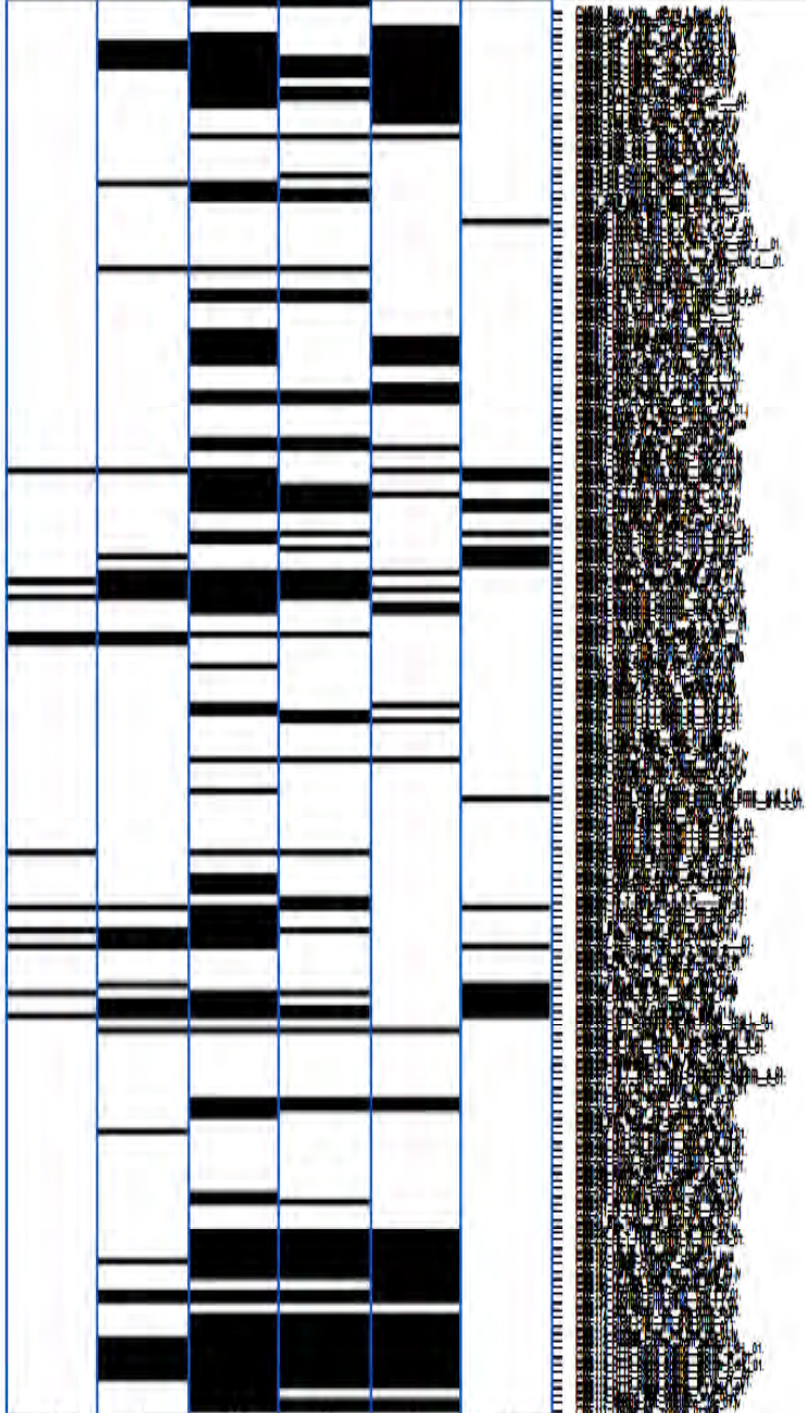
Organizations Participating: 29
Products & Services: 48

December 29, 2006

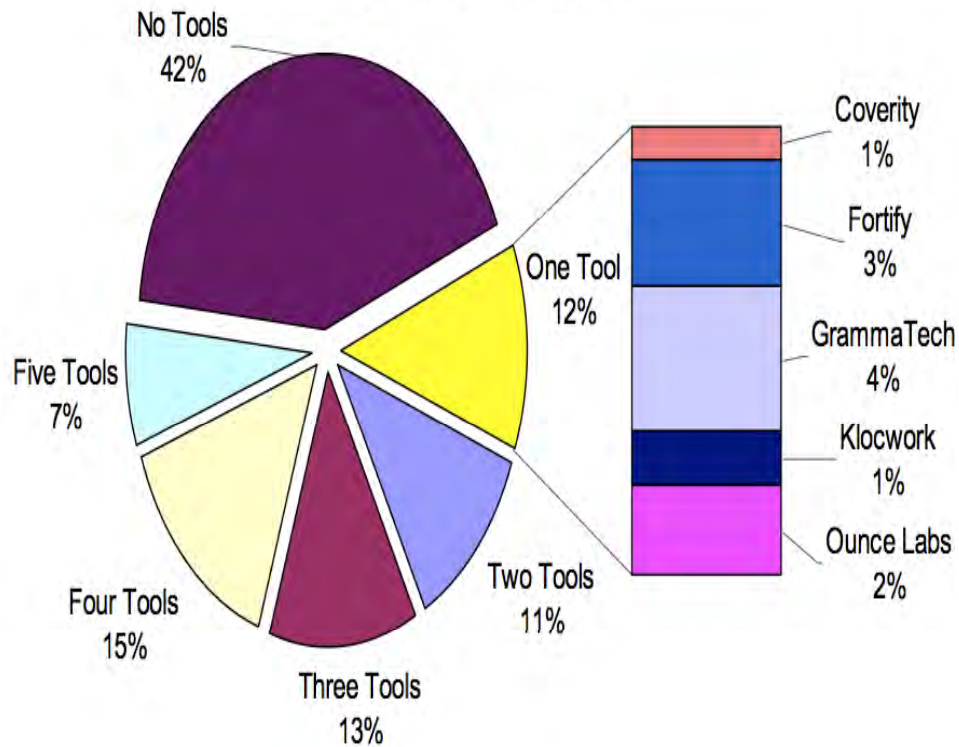
C Test Cases



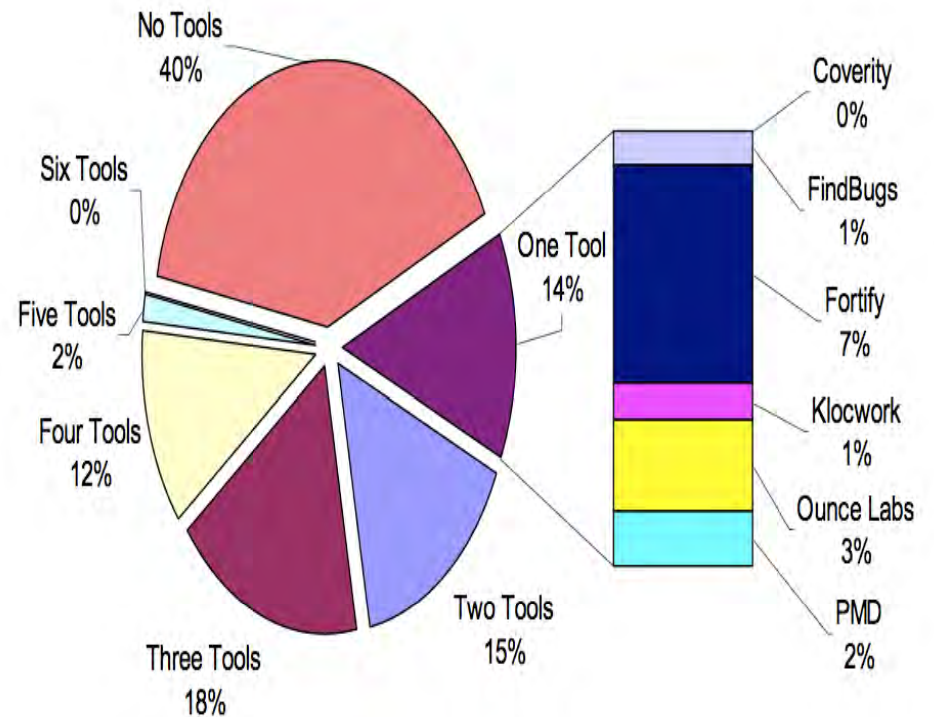
Java Test Cases



C/C++ “Breadth” Test Case Coverage



Java “Breadth” Test Case Coverage



Code Analysis Effectiveness Assessment...



CWE
Validation
Effectiveness
Testing - ?

CWE
Compatibility
and
Effectiveness

CWEs with
WhiteBox
Definitions

Center For
Assure SW
Tool Evaluation
2007
Tool Evaluation
2009

IARPA
STONESOUP-
Securely Taking
On New
Executable Stuff
Of Uncertain
Provenance

NIST
SAMATE
SP 500-267
SP 500-269
SP 500-270

SAMATE
Repository
Dataset
(SRD)

Automated
Test Case
Generator

NIST SATE
SATE08
SATE09
SATE10

SySA Task
Force
WhiteBox
Definitions-to-
SBVR-to-
microKDM

All of these are aimed at different aspects of understanding how well tools find CWEs in software applications and what can be done to improve that and standardize the process for expressing a tools capabilities.

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PLOVER
(CWE
draft 1)

CWE
draft 5

CWE
draft 7

CWE
Vers
1.0

CWE
Vers
1.5

CWE
Vers
1.1

**With all of
these CWEs,
where do you
start?**

2005

300 nodes

2006

599 nodes

2007

634 nodes

2008

673 nodes

2009

799 nodes

Dec 2010

835 nodes

2009 SANS/CWE Top 25 Programming Errors

(released 12 Jan 2009) cwe.mitre.org/top25/

- List selected by security experts from 34 organizations

The screenshot shows the SANS Institute website with the title "SANS Institute - CWE/SANS TOP 25 Most Dangerous Programming Errors". The page features a navigation bar with links like "why SANS?", "pick a course", "why certify?", "register now", and a search bar. The main content area is titled "CWE/SANS TOP 25 Most Dangerous Programming Errors" and includes a sidebar with links to "CWE List", "About", "Community", "News", "Compatibility", and "Contact Us". The main text area contains the title "2009 CWE/SANS Top 25 Most Dangerous Programming Errors", the document version "1.0 (pdf)", the date "January 12, 2009", and the project coordinators: Bob Martin (MITRE), Mason Brown (SANS), and Alan Paller (SANS). The document editor is listed as Steve Christey (MITRE). The introduction text states: "The 2009 CWE/SANS Top 25 Most Dangerous Programming Errors is a list of the most significant programming errors that can lead to serious software vulnerabilities. They occur frequently, are often easy to find, and easy to exploit. They are dangerous because they will frequently allow attackers to completely take over the software, steal data, or prevent the software from working at all." The page also includes a "Section Contents" sidebar with links to "Supporting Quotes", "Contributors", "On the Cusp", "Top 25 FAQ", "Top 25 Process", and "Change Log".

SANS The right security
training certification resources

CWE Common Weakness Enumeration
A Community-Developed Dictionary of Software Weakness Types

Home > CWE/SANS Top 25

Search by ID: Go

2009 CWE/SANS Top 25 Most Dangerous Programming Errors

Document version: 1.0 ([pdf](#)) **Date:** January 12, 2009

Project Coordinators:
Bob Martin (MITRE)
Mason Brown (SANS)
Alan Paller (SANS)

Document Editor:
Steve Christey (MITRE)

Introduction

The 2009 CWE/SANS Top 25 Most Dangerous Programming Errors is a list of the most significant programming errors that can lead to serious software vulnerabilities. They occur frequently, are often easy to find, and easy to exploit. They are dangerous because they will frequently allow attackers to completely take over the software, steal data, or prevent the software from working at all.

The list is the result of collaboration between the SANS Institute, MITRE, and many top software security experts in the US and Europe. It leverages experiences in the development of the SANS Top 20 attack vectors (<http://www.sans.org/top20/>) and MITRE's Common Weakness Enumeration (CWE) (<http://cwe.mitre.org/>). MITRE maintains the CWE web site, with the support of the US Department of Homeland Security's National Cyber Security Division, presenting detailed descriptions of the top 25 programming errors along with authoritative guidance for mitigating and avoiding them. The CWE site also contains data on more than 700 additional programming errors, design errors, and architecture errors that can lead to exploitable vulnerabilities.

The main goal for the Top 25 list is to stop vulnerabilities at the source by educating programmers on how to eliminate all-too-common mistakes before software is even shipped. The list will be a tool for education and awareness that will help programmers to prevent the kinds of vulnerabilities that plague the software industry. Software consumers could use the same list to help them to ask for more secure software. Finally, software managers and CIOs can use the Top 25 list as a measuring stick of progress in their efforts to secure their software.

Section Contents
CWE/SANS Top 25
Supporting Quotes
Contributors
On the Cusp
Top 25 FAQ
Top 25 Process
Change Log

Copyright © 2009
The MITRE Corporation
<http://cwe.mitre.org/top25>

CWE List
Full Dictionary View
Development View
Research View
Reports

About
Sources
Process
Documents

Community
Related Activities
Discussion List
Research
CWE/SANS Top 25
CWSS

News
Calendar
Free Newsletter

Compatibility
Program
Requirements
Declarations
Make a Declaration

Contact Us
Search the Site

Experts Announce Agreement on the
And How to Fix Them
Agreement Will Change How Organ
Project Manager: Bob Martin, MITRE
Questions: top25@sans.org
PDF For Printing

(January 12, 2009) Today in Washington, DC, experts from the most respected security experts and they Microsoft, to DHS's National Cyber Security Division, the Japanese IPA, to the University of California, Institute managed the Top 25 Errors initiative, the Security Agency and financial support for MITRE Homeland Security's National Cyber Security Division, National Cybersecurity Division at DHS have come together to improve the security of software purchased by the federal government.

The impact of these errors is far reaching. Just during 2008 - and those breaches case studies, turning their computers into zombies.

People and organizations that provided substantial support to the most respected security experts and they Microsoft, to DHS's National Cyber Security Division, the Japanese IPA, to the University of California, Institute managed the Top 25 Errors initiative, the Security Agency and financial support for MITRE Homeland Security's National Cyber Security Division, National Cybersecurity Division at DHS have come together to improve the security of software purchased by the federal government.

What was remarkable about the process was the heated discussion. There appears to be broad agreement on the list. Now it is time to fix them. First, write code that is free of the Top 25 errors, and then, processes in place to find, fix, or avoid these errors. Finally, software managers and CIOs can use the Top 25 list as a measuring stick of progress in their efforts to secure their software.

The Office of the Director of National Intelligence

Making
Security
Measurable™

2010 CWE/SANS Top 25 Programming Errors (released 16 Feb 2010)

cwe.mitre.org/top25/

- List selected by security experts from 34 organizations

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The most trusted source for computer security training, certification and research.

training certification resources vendor portal storm center college developer about

CWE/SANS TOP 25 Most Dangerous Programming Errors

SANS FIRE 2010 Baltimore, MD June 6-14
Forensics, Investigations, Response, and Education

What Errors Are Included in the Top 25 P

Version 2.0 Updated February 16, 2010

The Top 25 Programming Errors are listed below

- Programming Error Category: Insecure Interaction Between
- Programming Error Category: Risky Resource Management (
- Programming Error Category: Porous Defenses (7 errors)

Click on the headline in any of the listings (or the MORE link) and y the MITRE CWE site where you will find the following:

- Ranking of each Top 25 entry,
- Links to the full CWE entry data,
- Data fields for weakness prevalence and consequences,
- Remediation cost,
- Ease of detection,
- Code examples,
- Detection Methods,
- Attack frequency and attacker awareness
- Related CWE entries, and
- Related patterns of attack for this weakness.

Each entry at the Top 25 Programming Errors site also includes fair steps that developers can take to mitigate or eliminate the weakn

[View Press Release concerning the 2010 Updates](#)

[View the Top 25 Programming Errors for 2009 Here](#)

Programming Error Category: Insecure Interacti

[1] CWE-79: Failure to Preserve Web Page Structu
Cross-site scripting (XSS) is one of the most prevalent, obstinate, and applications...if you're not careful, attackers can...[MORE >>](#)

[2] CWE-89: Failure to Preserve SQL Query Structu
If attackers can influence the SQL that you use to communicate w

CWE Common Weakness Enumeration
A Community-Developed Dictionary of Software Weakness Types

Home > CWE/SANS Top 25 2010

2010 CWE/SANS Top 25 Most Dangerous Software Errors

Copyright © 2010 The MITRE Corporation
<http://cwe.mitre.org/top25/>

Document version: 1.06 ([pdf](#)) **Date:** September 27, 2010

Project Coordinators:
Bob Martin (MITRE)
Mason Brown (SANS)
Alan Paller (SANS)
Dennis Kirby (SANS)

Document Editor:
Steve Christey (MITRE)

Introduction

The 2010 CWE/SANS Top 25 Most Dangerous Software Errors is a list of the most widespread and critical programming errors that can lead to serious software vulnerabilities. They are often easy to find, and easy to exploit. They are dangerous because they will frequently allow attackers to completely take over the software, steal data, or prevent the software from working at all.

The Top 25 list is a tool for education and awareness to help programmers to prevent the kinds of vulnerabilities that plague the software industry, by identifying and avoiding all-too-common mistakes that occur before software is even shipped. Software customers can use the same list to help them to ask for more secure software. Researchers in software security can use the Top 25 to

Section Contents
CWE/SANS Top 25
Contributors
Supporting Quotes
Monster Mitigations
Focus Profiles
On the Cusp
Documents & Podcasts
Training Materials
Top 25 FAQ
Top 25 Process
Change Log
SANS News Release

Section Archives
2009 CWE/SANS Top 25
Supporting Quotes
Contributors
On The Cusp
Change Log

Done

Making
Security
Measurable™

Main Goals

- Raise awareness for developers
- Help universities to teach secure coding
- Empower customers who want to ask for more secure software
- Provide a starting point for in-house software shops to measure their own progress

Ryan Barnett	Breach
Antonio Fontes	New Act
Mark Fioravanti II	Missing

2010



2009



Insecure Interaction Between Components

These weaknesses are related to insecure ways in which data is sent and received between separate components, modules, programs, processes, threads, or systems.

- [CWE-20](#): Improper Input Validation
- [CWE-116](#): Improper Encoding or Escaping of Output
- [CWE-89](#): Failure to Preserve SQL Query Structure (aka 'SQL Injection')
- [CWE-79](#): Failure to Preserve Web Page Structure (aka 'Cross-site Scripting')
- [CWE-78](#): Failure to Preserve OS Command Structure (aka 'OS Command Injection')
- [CWE-319](#): Cleartext Transmission of Sensitive Information
- [CWE-352](#): Cross-Site Request Forgery (CSRF)
- [CWE-362](#): Race Condition
- [CWE-209](#): Error Message Information Leak

Risky Resource Management

The weaknesses in this category are related to ways in which software does not properly manage the creation, usage, transfer, or destruction of important system resources.

- [CWE-119](#): Failure to Constrain Operations within the Bounds of a Memory Buffer
- [CWE-642](#): External Control of Critical State Data
- [CWE-73](#): External Control of File Name or Path
- [CWE-426](#): Untrusted Search Path
- [CWE-94](#): Failure to Control Generation of Code (aka 'Code Injection')
- [CWE-494](#): Download of Code Without Integrity Check
- [CWE-404](#): Improper Resource Shutdown or Release
- [CWE-665](#): Improper Initialization
- [CWE-682](#): Incorrect Calculation

Porous Defenses

The weaknesses in this category are related to defensive techniques that are often misused, abused, or just plain ignored.

- [CWE-285](#): Improper Access Control (Authorization)
- [CWE-327](#): Use of a Broken or Risky Cryptographic Algorithm
- [CWE-259](#): Hard-Coded Password
- [CWE-732](#): Insecure Permission Assignment for Critical Resource
- [CWE-330](#): Use of Insufficiently Random Values
- [CWE-250](#): Execution with Unnecessary Privileges
- [CWE-602](#): Client-Side Enforcement of Server-Side Security

Insecure Interaction Between Components

These weaknesses are related to insecure ways in which data is sent and received between separate components, modules, programs, processes, threads, or systems.

For each weakness, its ranking in the general list is provided in square brackets.

Rank	CWE ID	Name
[1]	CWE-79	Failure to Preserve Web Page Structure ('Cross-site Scripting')
[2]	CWE-89	Improper Sanitization of Special Elements used in an SQL Command ('SQL Injection')
[4]	CWE-352	Cross-Site Request Forgery (CSRF)
[8]	CWE-434	Unrestricted Upload of File with Dangerous Type
[9]	CWE-78	Improper Sanitization of Special Elements used in an OS Command ('OS Command Injection')
[17]	CWE-209	Information Exposure Through an Error Message
[23]	CWE-601	URL Redirection to Untrusted Site ('Open Redirect')
[25]	CWE-362	Race Condition

Risky Resource Management

The weaknesses in this category are related to ways in which software does not properly manage the creation, usage, transfer, or destruction of important system resources.

Rank	CWE ID	Name
[3]	CWE-120	Buffer Copy without Checking Size of Input ('Classic Buffer Overflow')
[7]	CWE-22	Improper Limitation of a Pathname to a Restricted Directory ('Path Traversal')
[12]	CWE-805	Buffer Access with Incorrect Length Value
[13]	CWE-754	Improper Check for Unusual or Exceptional Conditions
[14]	CWE-98	Improper Control of Filename for Include/Require Statement in PHP Program ('PHP File Inclusion')
[15]	CWE-129	Improper Validation of Array Index
[16]	CWE-190	Integer Overflow or Wraparound
[18]	CWE-131	Incorrect Calculation of Buffer Size
[20]	CWE-494	Download of Code Without Integrity Check
[22]	CWE-770	Allocation of Resources Without Limits or Throttling

Porous Defenses

The weaknesses in this category are related to defensive techniques that are often misused, abused, or just plain ignored.

Rank	CWE ID	Name
[5]	CWE-285	Improper Access Control (Authorization)
[6]	CWE-807	Reliance on Untrusted Inputs in a Security Decision
[10]	CWE-311	Missing Encryption of Sensitive Data
[11]	CWE-798	Use of Hard-coded Credentials
[19]	CWE-306	Missing Authentication for Critical Function
[21]	CWE-732	Incorrect Permission Assignment for Critical Resource
[24]	CWE-327	Use of a Broken or Risky Cryptographic Algorithm

2 **CWE-89: Improper Neutralization of Special Elements used in an SQL Command ('SQL Injection')**

Summary

Weakness Prevalence	High	Consequences	Data loss, Security bypass
Remediation Cost	Low	Ease of Detection	Easy
Attack Frequency	Often	Attacker Awareness	High

Discussion

These days, it seems as if software is all about the data: getting it into the database, pulling it from the database, massaging it into information, and sending it elsewhere for fun and profit. If attackers can influence the SQL that you use to communicate with your database, then suddenly all your fun and profit belongs to them. If you use SQL queries in security controls such as authentication, attackers could alter the logic of those queries to bypass security. They could modify the queries to steal, corrupt, or otherwise change your underlying data. They'll even steal data one byte at a time if they have to, and they have the patience and know-how to do so.

[Technical Details](#) | [Code Examples](#) | [Detection Methods](#) | [References](#)

Prevention and Mitigations

Architecture and Design

Use a vetted library or framework that does not allow this weakness to occur or provides constructs that make this weakness easier to avoid.

For example, consider using persistence layers such as Hibernate or Enterprise Java Beans, which can provide significant protection against SQL injection if used properly.

Architecture and Design

If available, use structured mechanisms that automatically enforce the separation between data and code. These mechanisms may be able to provide the relevant quoting, encoding, and validation automatically, instead of relying on the developer to provide this capability at every point where output is generated.

Process SQL queries using prepared statements, parameterized queries, or stored procedures. These features should accept parameters or variables and support strong typing. Do not dynamically construct and execute query strings within these features using "exec" or similar functionality, since you may

Monster Mitigations

These mitigations will be effective in eliminating or reducing the severity of the Top 25. These mitigations will also address many weaknesses that are not even on the Top 25. If you adopt these mitigations, you are well on your way to making more secure software.

A [Monster Mitigation Matrix](#) is also available to show how these mitigations apply to weaknesses in the Top 25.

ID	Description
M1	Establish and maintain control over all of your inputs.
M2	Establish and maintain control over all of your outputs.
M3	Lock down your environment.
M4	Assume that external components can be subverted, and your code can be read by anyone.
M5	Use industry-accepted security features instead of inventing your own.
GP1	(general) Use libraries and frameworks that make it easier to avoid introducing weaknesses.
GP2	(general) Integrate security into the entire software development lifecycle.
GP3	(general) Use a broad mix of methods to comprehensively find and prevent weaknesses.
GP4	(general) Allow locked-down clients to interact with your software.

M1	M2	M3	M4	M5	CWE
High		DiD	Mod		CWE-22 : Improper Limitation of a Pathname to a Restricted Directory ('Path Traversal')
Mod	High	DiD	Ltd		CWE-78 : Improper Sanitization of Special Elements used in an OS Command ('OS Command Injection')
Mod	High		Ltd		CWE-79 : Failure to Preserve Web Page Structure ('Cross-site Scripting')
Mod	High	DiD	Ltd		CWE-89 : Improper Sanitization of Special Elements used in an SQL Command ('SQL Injection')
Mod		DiD	Ltd		CWE-98 : Improper Control of Filename for Include/Require Statement in PHP Program ('PHP File Inclusion')
Mod		DiD	Ltd		CWE-120 : Buffer Copy without Checking Size of Input ('Classic Buffer Overflow')
High		DiD	Ltd		CWE-129 : Improper Validation of Array Index
Mod		DiD	Ltd		CWE-131 : Incorrect Calculation of Buffer Size
Mod		DiD	Ltd		CWE-190 : Integer Overflow or Wraparound
Ltd	High	DiD	Mod		CWE-209 : Information Exposure Through an Error Message
		DiD	Mod	Mod	CWE-285 : Improper Access Control (Authorization)
		Mod		Mod	CWE-306 : Missing Authentication for Critical Function
		DiD			CWE-311 : Missing Encryption of Sensitive Data
				High	CWE-327 : Use of a Broken or Risky Cryptographic Algorithm
			Ltd		CWE-352 : Cross-Site Request Forgery (CSRF)
		DiD			CWE-362 : Race Condition
Mod		DiD	Mod		CWE-434 : Unrestricted Upload of File with Dangerous Type
		DiD			CWE-494 : Download of Code Without Integrity Check
Mod	Mod		Ltd		CWE-601 : URL Redirection to Untrusted Site ('Open Redirect')
	Ltd	DiD		Mod	CWE-732 : Incorrect Permission Assignment for Critical Resource
Mod	Ltd	DiD			CWE-754 : Improper Check for Unusual or Exceptional Conditions
Ltd		DiD	Ltd		CWE-770 : Allocation of Resources Without Limits or Throttling
		DiD	High	Mod	CWE-798 : Use of Hard-coded Credentials
Mod		DiD	Ltd		CWE-805 : Buffer Access with Incorrect Length Value
Mod		DiD	Mod	Mod	CWE-807 : Reliance on Untrusted Inputs in a Security Decision

Focus Profiles

The prioritization of items in the general Top 25 list is just that - general. The rankings, and even the selection of which items should be included, can vary widely depending on context. Ideally, each organization can decide how to rank weaknesses based on its own criteria, instead of relying on a single general-purpose list.

A separate document provides several "focus profiles" with their own criteria for selection and ranking, which may be more useful than the general list.

Name	Description
<u>On the Cusp: Weaknesses that Did Not Make the 2010 Top 25</u>	From the original nominee list of 41 submitted CWE entries, the Top 25 was selected. This "On the Cusp" profile includes the remaining 16 weaknesses that did not make it into the final Top 25.
<u>Educational Emphasis</u>	This profile ranks weaknesses that are important from an educational perspective within a school or university context. It focuses on the CWE entries that graduating students should know, including historically important weaknesses.
<u>Weaknesses by Language</u>	This profile specifies which weaknesses appear in which programming languages. Notice that most weaknesses are actually language-independent, although they may be more prevalent in one language or another.
<u>Weaknesses Typically Fixed in Design or Implementation</u>	This profile lists weaknesses that are typically fixed in design or implementation.
<u>Automated vs. Manual Analysis</u>	This profile highlights which weaknesses can be detected using automated versus manual analysis. Currently, there is very little public, authoritative information about the efficacy of these methods and their utility. There are many competing opinions, even among experts. As a result, these ratings should only be treated as guidelines, not rules.
<u>Weaknesses by Language</u>	This profile specifies which weaknesses appear in which programming languages. Notice that most weaknesses are actually language-independent, although they may be more prevalent in one language or another.
<u>For Developers with Established Software Security Practices</u>	This profile is for developers who have already established security in their practice. It uses votes from the major developers who contributed to the Top 25.
<u>Ranked by Importance - for Software Customers</u>	This profile ranks weaknesses based primarily on their importance, as determined from the base voting data that was used to create the general list. Prevalence is included in the scores, but it has much less weighting than importance.
<u>Weaknesses by Technical Impact</u>	This profile lists weaknesses based on their technical impact, i.e., what an attacker can accomplish by exploiting each weakness.

Background Details to Check Out

cwe.mitre.org/top25

- Process description
- Changelog for each revision
- On the Cusp – weaknesses that almost made it
- Appendices
 - **Selection Criteria and Supporting Fields**
 - **Threat Model for the Skilled, Determined Attacker**

Frequently Asked Questions (FAQ)

How is this different from the OWASP Top Ten?

The short answer is that the OWASP Top Ten covers more general concepts and is focused on web applications. The CWE Top 25 covers a broader range of issues than what arise from the web-centric view of the OWASP Top Ten, such as buffer overflows. Also, one goal of the CWE Top 25 is to be at a level that is directly actionable to programmers, so it contains more detailed issues than the categories being used in the Top Ten. There is some overlap, however, since web applications are so prevalent, and some issues in the Top Ten have general applications to all classes of software.

How are the weaknesses prioritized on the list?

With the exception of Input Validation being listed as number 1 (partially for educational purposes), there is no concrete prioritization. Prioritization differs widely depending on the audience (e.g. web application developers versus OS developers) and the risk tolerance (whether code execution, data theft, or denial of service are more important). It was also believed that the use of categories would help the organization of the document, and prioritization would impose a different ordering.

Why are you including overlapping concepts like input validation and XSS, or incorrect calculation and buffer overflows? Why do you have mixed levels of abstraction?

While it would have been ideal to have a fixed level of abstraction and no overlap between weaknesses, there are several reasons why this was not achieved.

Contributors sometimes suggested different CWE identifiers that were closely related. In some cases, this difference was addressed by using a more abstract CWE identifier that covered the relevant cases.

In other situations, there was strong advocacy for including lower-level issues such as SQL injection and cross-site scripting, so these were added. The general trend, however, was to use more abstract weakness types.

While it might be desired to minimize overlap in the Top 25, many vulnerabilities actually deal with the interaction of 2 or more weaknesses. For example, external control of user state data (CWE-642) could be an important weakness that enables cross-site scripting (CWE-79) and SQL injection (CWE-89). To eliminate overlap in the Top 25 would lose some of this important subtlety.

Finally, it was a conscious decision that if there was enough prevalence and severity, design-related weaknesses would be included. These are often thought of as being more abstract than weaknesses that arise during implementation.

The Top 25 list tries to strike a delicate balance between usability and relevance, and we believe that it does so, even with this apparent imperfection.

Why don't you use hard statistics to back up your claims?

The appropriate statistics simply aren't publicly available. The publicly available statistics are either too high-level or not comprehensive enough. And none of them are comprehensive across all software types and environments.

People are Starved for Simplicity

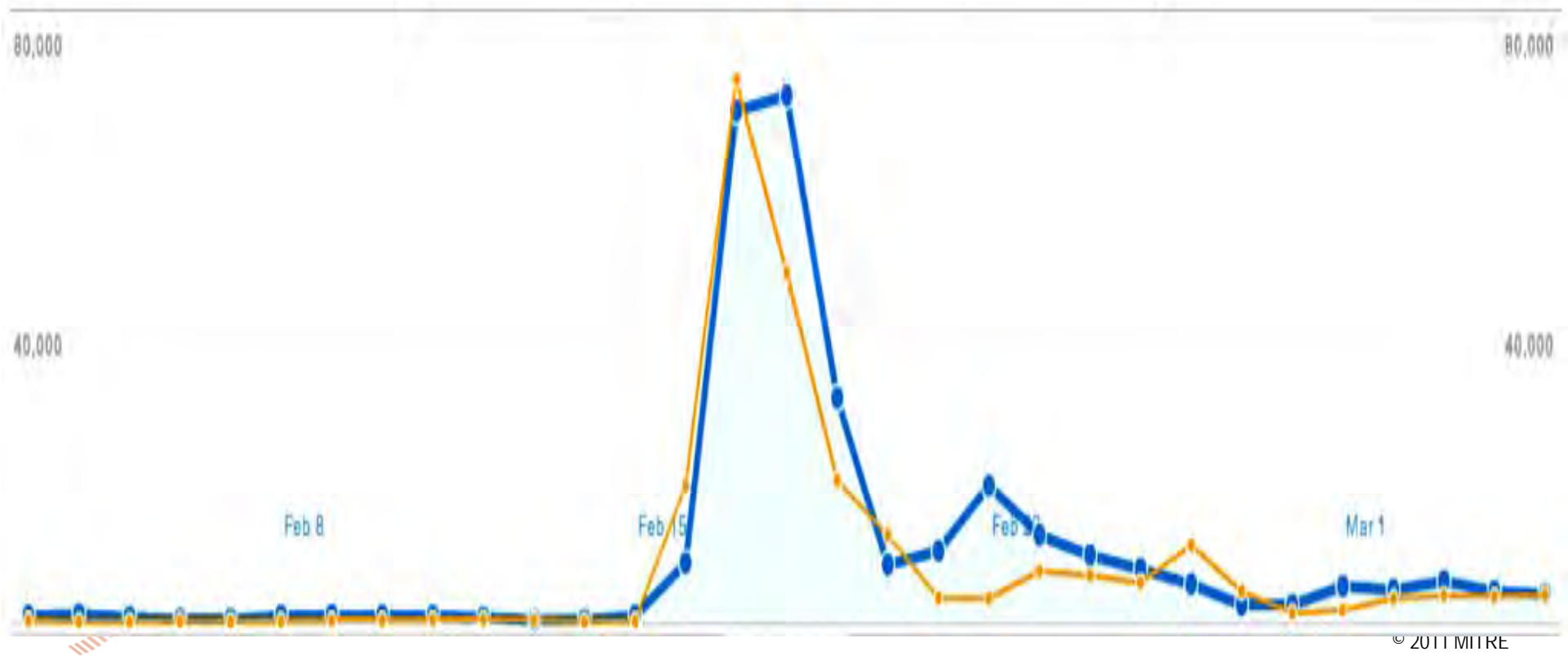
Google Analytics

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■● February 3, 2010 - March 5, 2010 -●- December 30, 2008 - January 29, 2009



The Top 25 is not...

- A silver bullet
- A guarantee of software health
- A perfect match for your unique needs
- As simple as it seems
- The only thing to include in contract language
- Completely found by tools

The Top 25 is...

- A mechanism for awareness
- A trigger of questions
- A place for mitigations
- A conversation starter
- A first step on the long road to software assurance

CWE Top 25 for 2011

- Started last month
- Utilizing the Common Weakness Scoring System (CWSS 0.4) and the Common Weakness Risk Assessment Framework (CWRAF 0.4) as under-pinning
- Will have numerous “Top 10’s” & one “Top 25”
 - **Including Web, Embedded, e-Voting,...**
- Final "master" Top 25 list, will leverage combined score from multiple vignettes.
- No fixed date for release of the 2011 Top 25 at this point, may take 2 to 3 months.

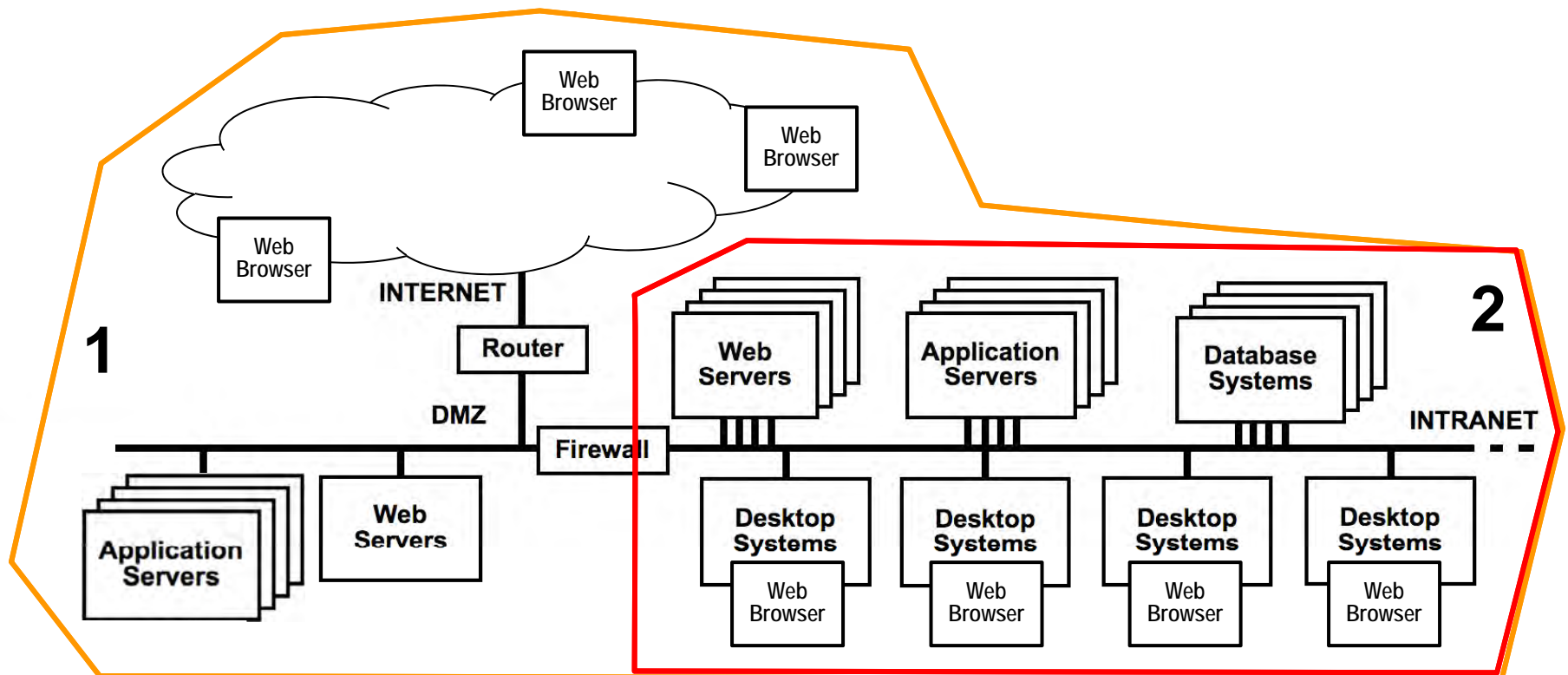
Common Weakness Scoring System (CWSS)

Archetypes:

- Web Browser User Interface
- Web Servers
- Application Servers
- Database Systems
- Desktop Systems
- SSL

Vignettes:

1. Web-based Retail Provider
2. Intranet resident health records management system of hospital



Business Value Context (BVC)

- Identifies critical assets and security concerns
- Links Technical Impacts (derived from CWE weaknesses) with business implications
- More fine-grained model than the CIA Triad

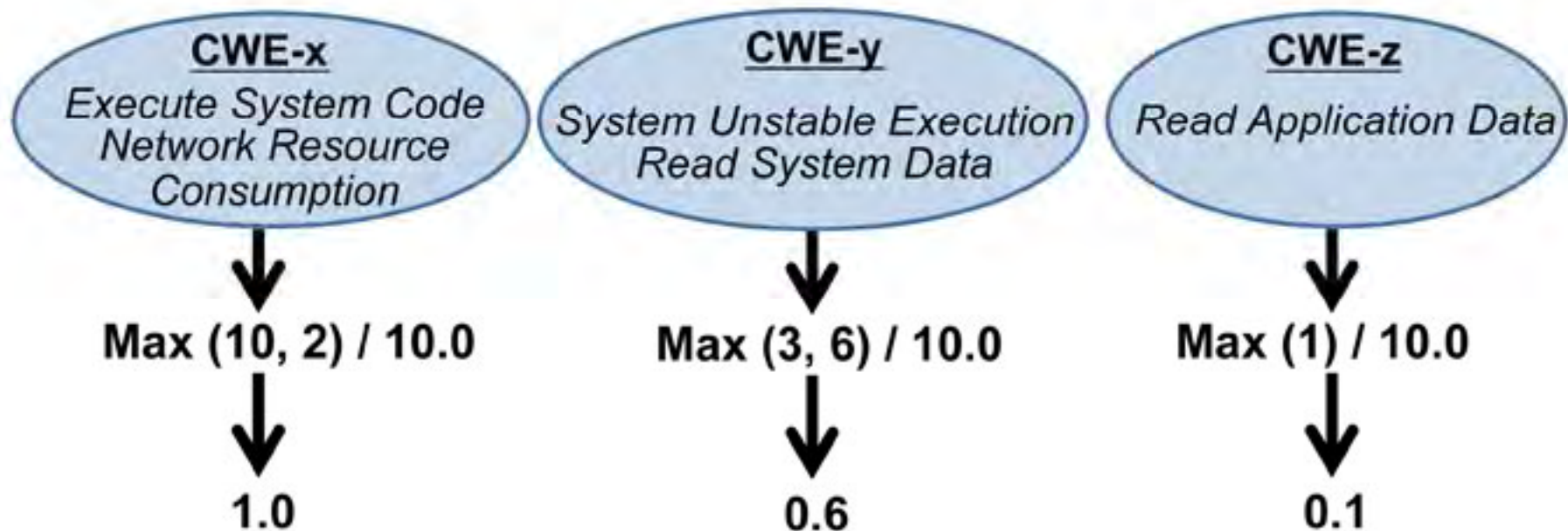
CWE Technical Impacts

- | | |
|--------------------------------|---|
| 1. Modify memory | 10. DoS: resource consumption (CPU) |
| 2. Read memory | 11. DoS: resource consumption (memory) |
| 3. Modify files or directories | 12. DoS: resource consumption (other) |
| 4. Read files or directories | 13. Execute unauthorized code or commands |
| 5. Modify application data | 14. Gain privileges / assume identity |
| 6. Read application data | 15. Bypass protection mechanism |
| 7. DoS: crash / exit / restart | 16. Hide activities |
| 8. DoS: amplification | |
| 9. DoS: instability | |

Calculating CWSS Impact Weights

10 – Execute System Code
6 – Read System Data
3 – System Unstable Execution
2 – Network Resource consumption
1 – Read Application Data

*Technical
Impact
Scorecard*



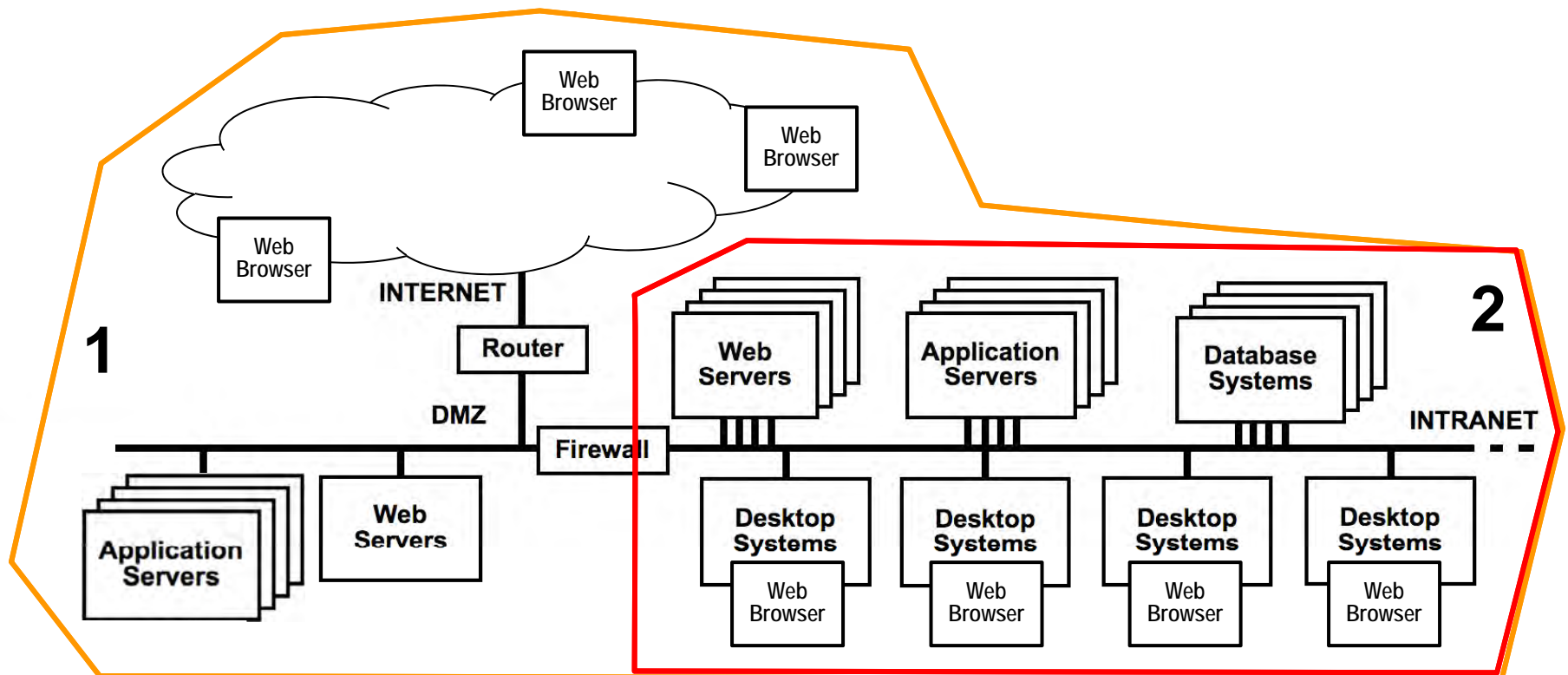
Common Weakness Scoring System (CWSS)

Archetypes:

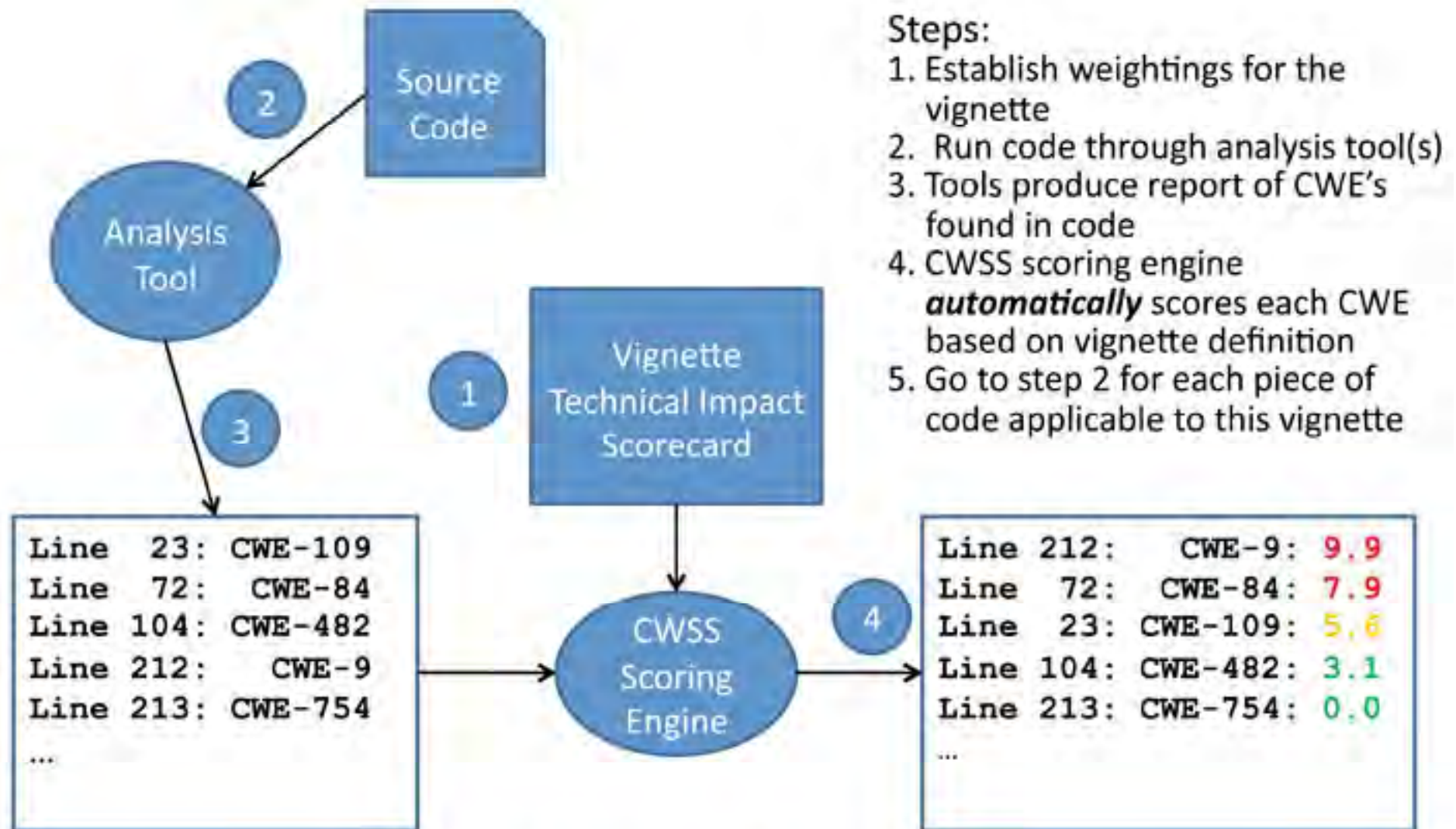
- Web Browser User Interface
- Web Servers
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Vignettes:

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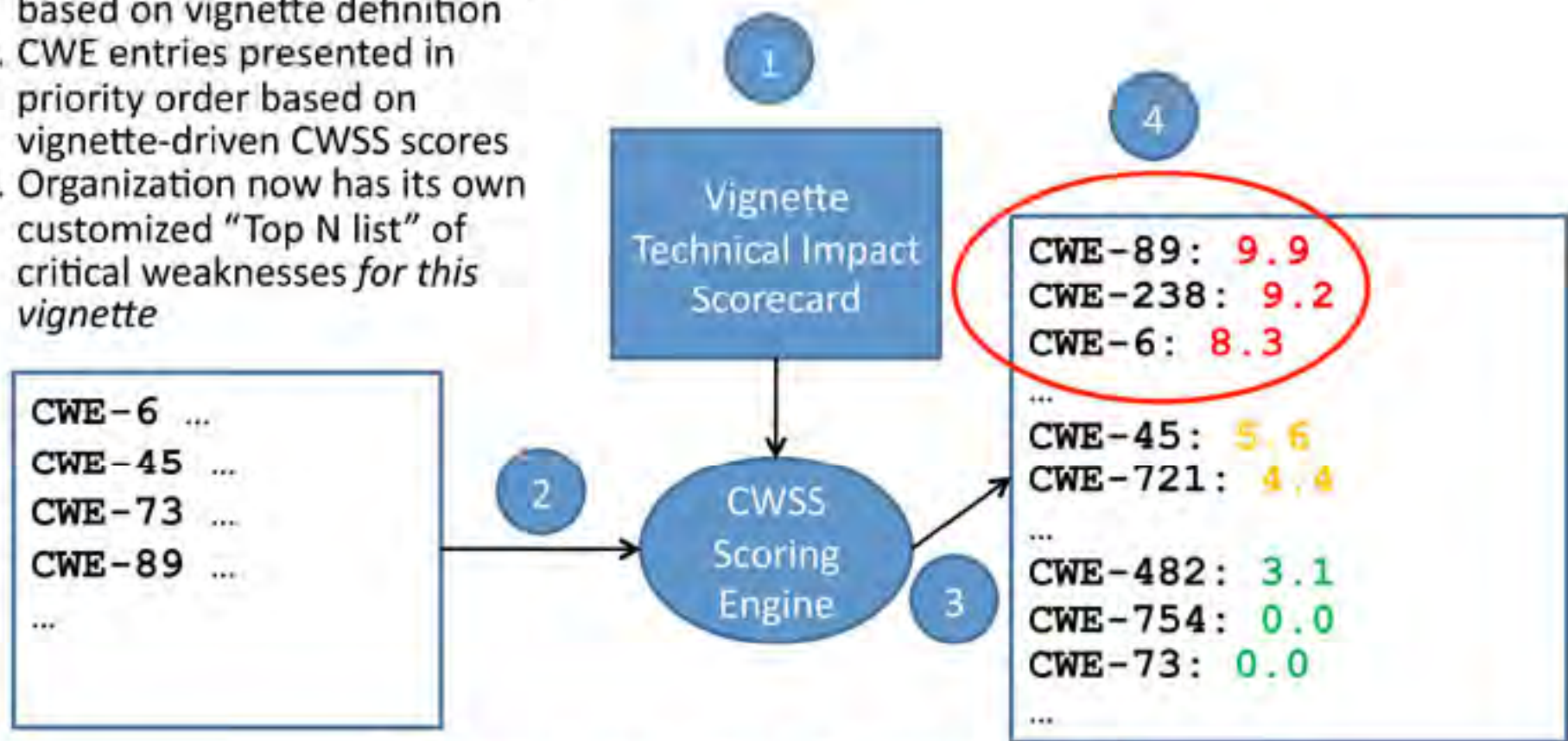
Scoring Weaknesses Discovered in Code using CWSS



Scoring Relevant Weaknesses using CWSS

Steps:

1. Establish weightings for the vignette
2. CWSS scoring engine processes each relevant CWE entry and *automatically* scores the entry based on vignette definition
3. CWE entries presented in priority order based on vignette-driven CWSS scores
4. Organization now has its own customized “Top N list” of critical weaknesses *for this vignette*



Step 1 is only done once – the rest is automatic

CWSS for a Technology Group

50%	Web Vignette 1 ...	TI(1), TI(2), TI(3),...	Top N List 1
10%	Web Vignette 2 ...	TI(1), TI(2), TI(3),...	Top N List 2
10%	Web Vignette 3 ...	TI(1), TI(2), TI(3),...	Top N List 3
10%	Web Vignette 4 ...	TI(1), TI(2), TI(3),...	Top N List 4
15%	Web Vignette 5 ...	TI(1), TI(2), TI(3),...	Top N List 5
15%	Web Vignette 6 ...	TI(1), TI(2), TI(3),...	Top N List 6
Web Application Technology Group			Top 10 List

CWE Top 10 List for Web Applications can be used to:

- Identify skill and training needs for your web team
- Include in T's & C's for contracting for web development
- Identify tool capability needs to support web assessment

Technology Group	Archetypes/Description
Web Applications	Web browser, web-server, web-based applications and services, etc.
Industrial Control Systems	SCADA, process control system, etc.
Real-time, Embedded Systems	Embedded Device, Programmable logic controller, implanted medical devices, avionics package.
End-point Computing Devices	Smart phone, laptop, personal digital assistant (PDA), and other remote devices that leave the enterprise and/or connect remotely to the enterprise.
Cloud Computing	Hosted applications or capabilities provided over the Internet, including Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS), and Infrastructure as a Service (IaaS).
Operating Systems	General-purpose OS, virtualized OS, Real-time operating system (RTOS), hypervisor, microkernel.
Enterprise Desktop Applications/Systems	Office products such as word processing, spreadsheets, project management, etc.

Domain Name	Description
E-Commerce	The use of the Internet or other computer networks for the sale of products and services, typically using on-line capabilities.
Banking & Finance	Financial services, including banks, stock exchanges, brokers, investment companies, financial advisors, and government regulatory agencies.
Public Health	Health care, medical encoding and billing, patient information/data, critical or emergency care, medical devices (implantable, partially embedded, patient care), drug development and distribution, food processing, clean water treatment and distribution (including dams and processing facilities), etc.
Energy	Smart Grid (electrical network through a large region, using digital technology for monitoring or control), nuclear power stations, oil and gas transmission, etc.
Chemical	Chemical processing and distribution, etc.
Manufacturing	Plants and distribution channels, supply chain, etc.
Shipping & Transportation	Aerospace systems (such as safety-critical ground aviation systems, on-board avionics, etc), shipping systems, rail systems, etc.
National Security	National security systems (including networks and weapon systems), Defense Industrial Base, etc.
Government and Commercial Security	Homeland Security systems, commercial security systems, etc.
Emergency Services	Systems and services that support first responders, incident management and response, law enforcement, and emergency services for citizens, etc.
Telecommunications	Cellular services, land lines, VOIP, cable & fiber networks, etc.
Telecommuting & Teleworking	Support for employees to have remote access to internal business networks and capabilities.
eVoting	Electronic voting systems, as used within state-run elections, shareholder meetings, etc.

Vignettes – Technology Groups & Business/Mission Domains

Technology Groups	Business/Mission Domains															
	e-Commerce	Banking & Finance	Energy (i.e., SmartGrid, nuclear power, oil/gas transmission)	Chemical	Manufacturing	Shipping & Transportation (i.e., rail, Freight, ships, airlines, aerospace, postal)	National Defense (i.e., intel networks, defense industrial base)	Homeland Security (CBP, Coast Guard, Secret Service, TSA, etc.)	Government (other than Nat'l Def & HS)	Emergency Services (law enforcement, Incident response, security services, etc.)	Public Health	Food & Water	Telecommunications	Teleworking	e-Voting	
Web Applications																
Real-Time Embedded Systems																
Control Systems																
End-Point Computing Devices																
Database & Storage Sys																
Operating Systems																
Identity Mngt Systems																
Enterprise Sys Apps																
Cloud Computing																

Common Vignette for Domain

Vignette for Domain/ Tech Gp

Common Vignette for Technology Group

Common Vignette for Technology Group

Vignette for Domain/ Tech Gp

Common Vignette for Domain

Vignette for Domain/Tech Gp

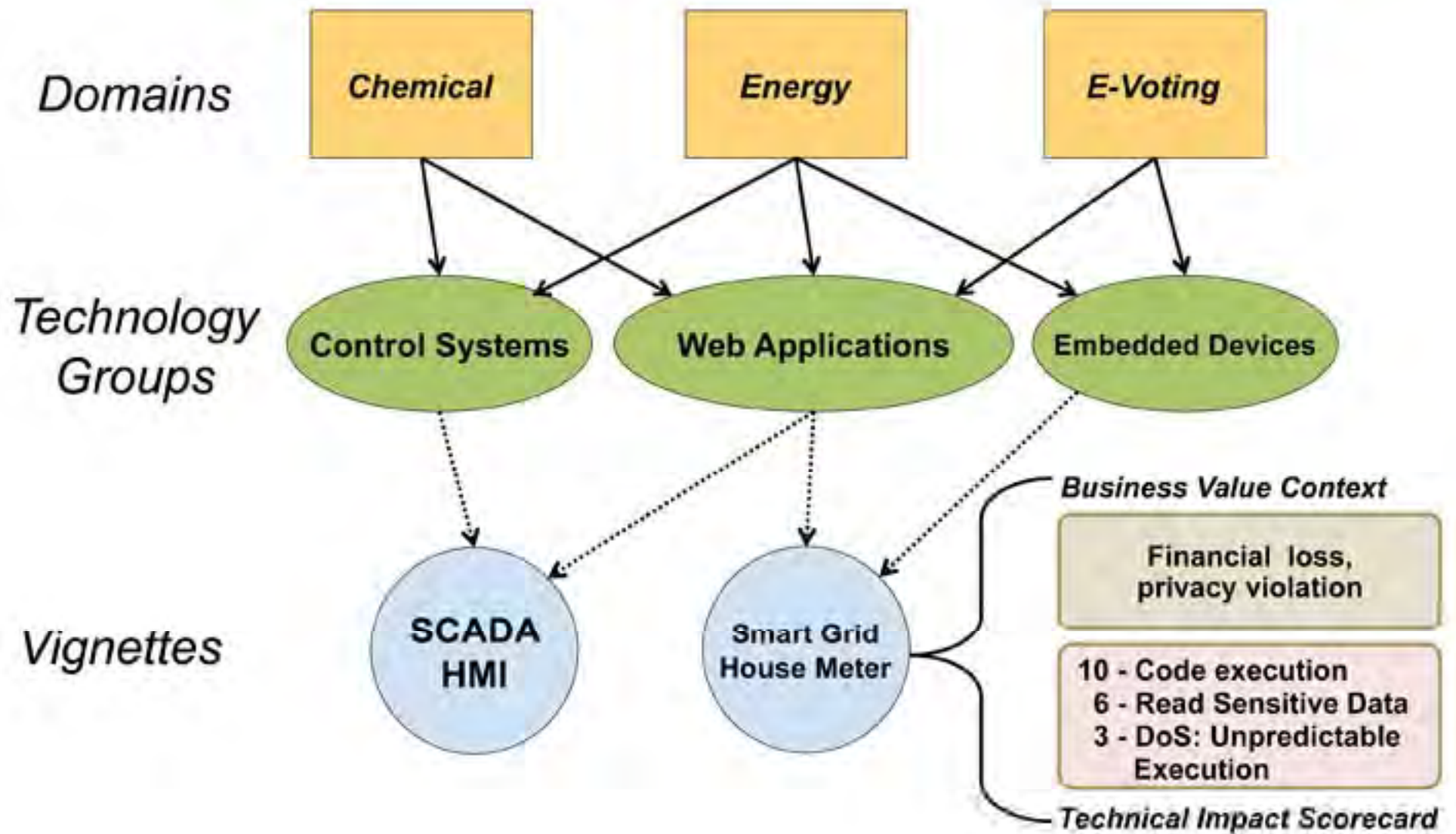
Common Vignette for Technology Group

Common Vignette for Technology Group

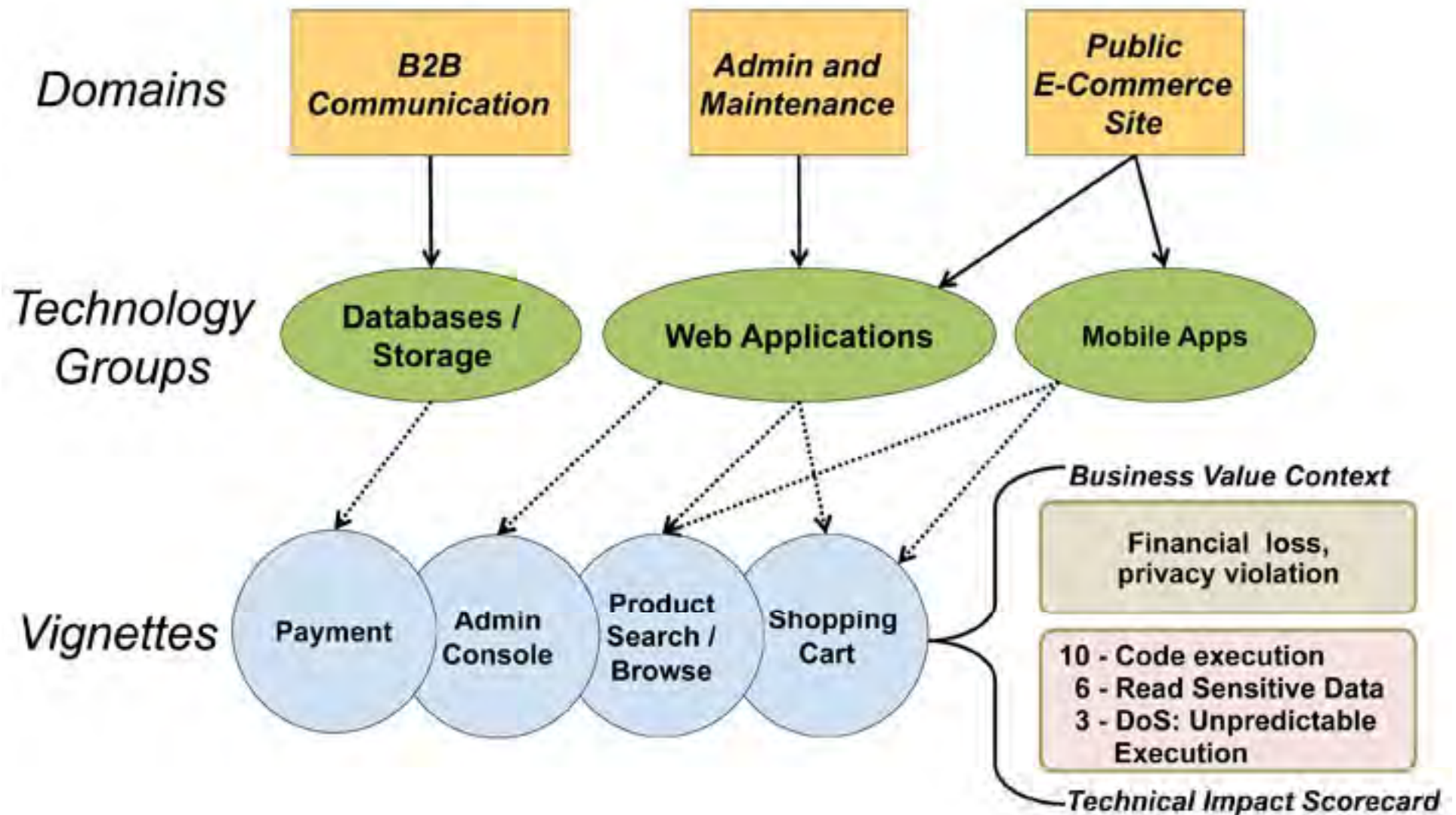
Vignette for Domain/Tech Gp

Common Weakness Risk Assessment Framework uses Vignettes with Archetypes to identify top CWEs in respective Domain/Technology Groups

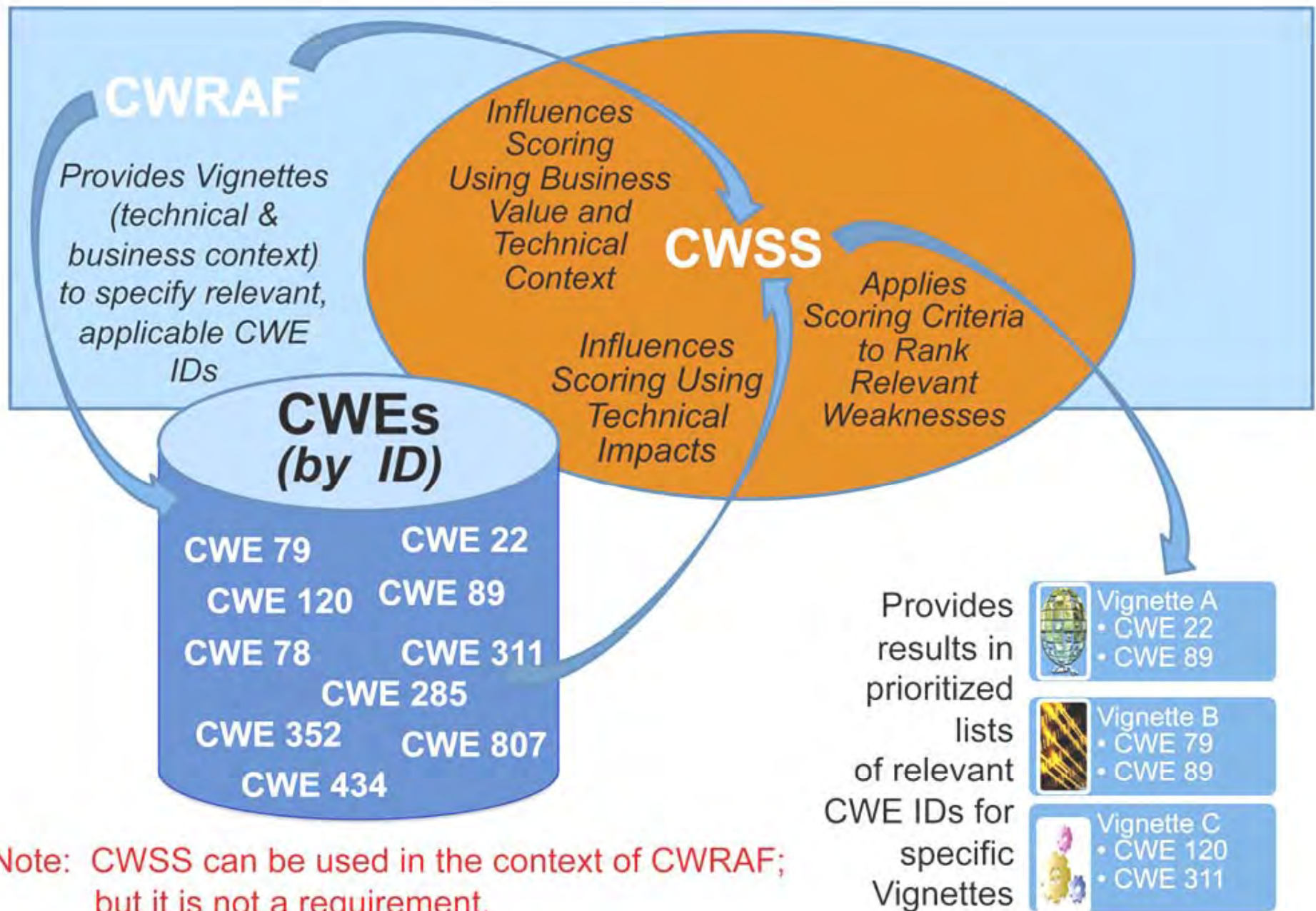
CWRAF: Common Weakness Risk Analysis Framework



Customizing CWRAF to a Single In-house Software Package



Relationships between CWRAF, CWSS, and CWE





Questions?

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